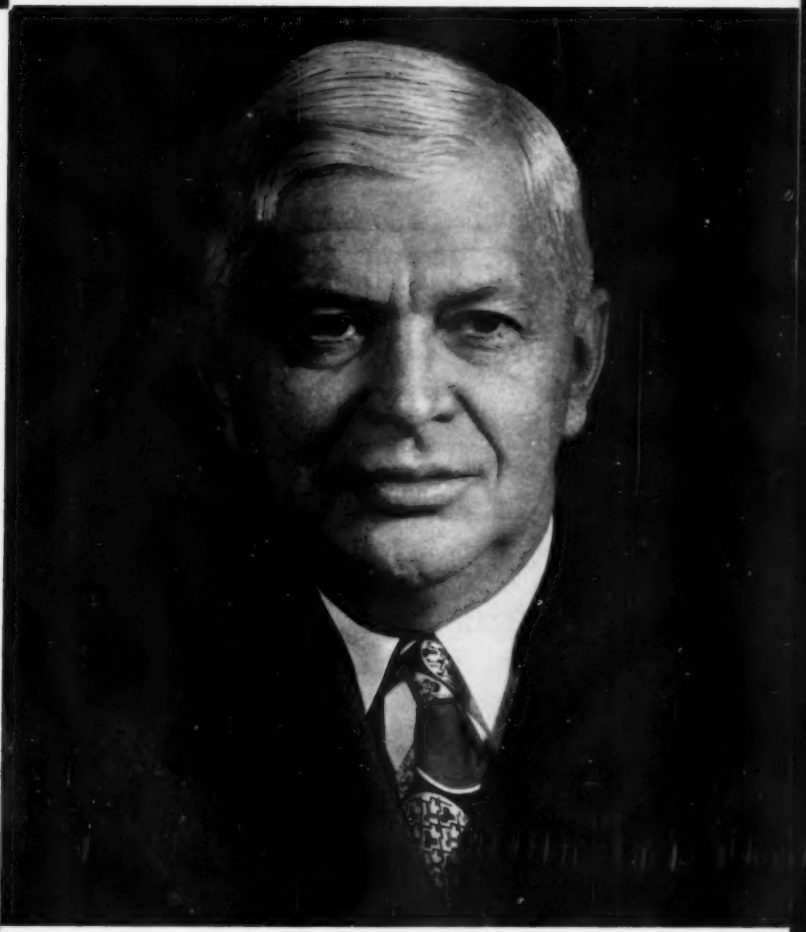
ORDNANCE

land ☆ sea ☆ air

Reg. U. S. Pat. Off.

VOLUME XXXVII NO. 197 MARCH-APRIL 1953



CHARLES E. WILSON
A new
Secretary of Defense
takes the helm

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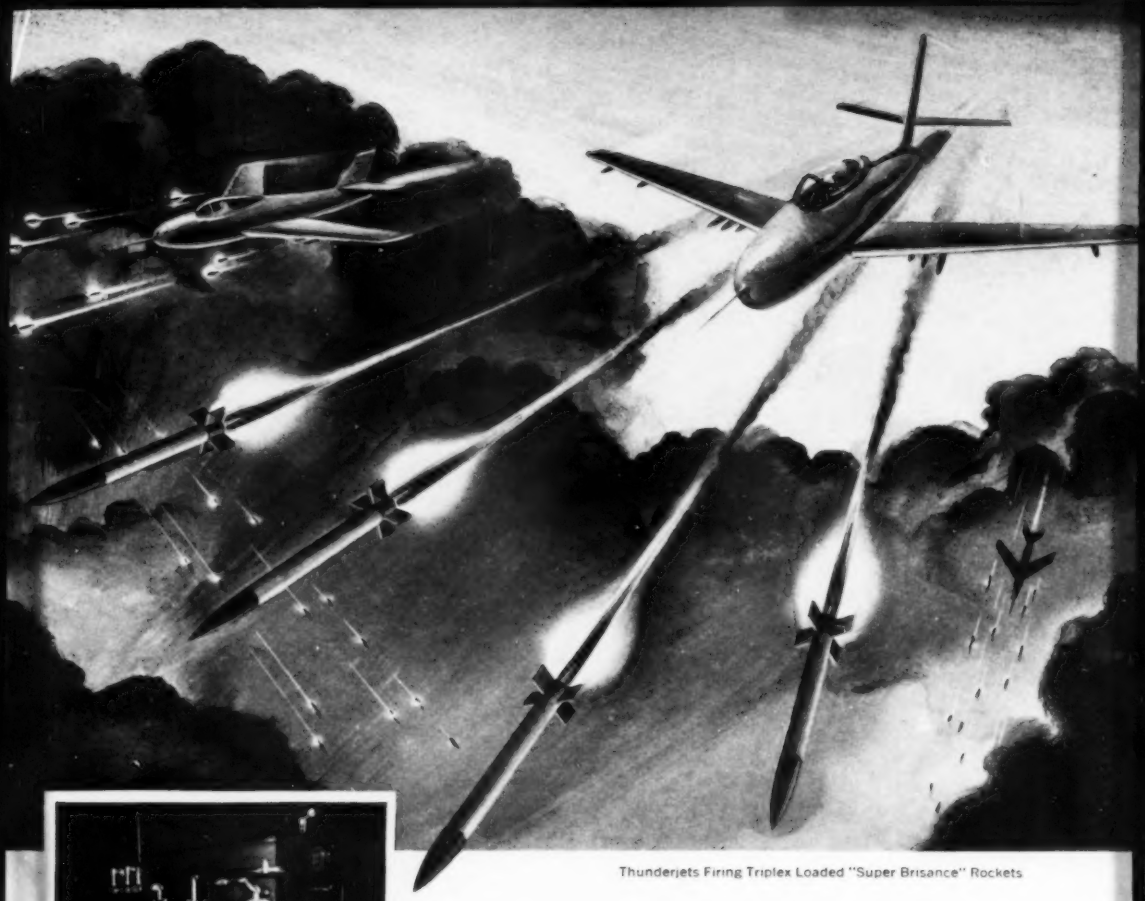
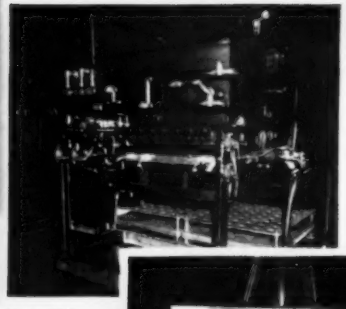


Thunderjets Firing Triplex Loaded "Super Brisance" Rockets



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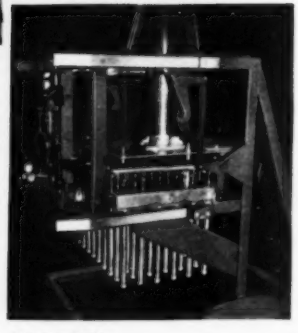

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The Magazine of Scientific and Industrial Preparedness

Vol. XXXVII MARCH-APRIL, 1953 No. 197

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ORDNANCE is published bimonthly by the American Ordnance Association, 705 Mills Building, Washington 6, D. C. Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Subscription rate: Continental U. S. and possessions, $4.50 annually, in advance; foreign, $6.00. Copyright 1953 by the American Ordnance Association. Title registered United States Patent Office. Six weeks' notice before next publication date required for change of address. ORDNANCE is combined with FIREPOWER and LOGISTICS, formerly published by the American Ordnance Association. *Editor:* Leo A. Codd. *Managing Editor:* R. E. Lewis. *Editorial Staff:* M. L. Van Horn, J. J. O'Connor, F. W. Foster Gleason, R. K. Smith. *Staff Assistants:* C. C. Alexander, G. C. Anderson, P. Cooke, G. M. Crump, L. F. Del Grosso, F. G. Ferriter, M. E. Ferriter, E. C. Hankey, R. La Rue, B. M. Rounds, M. J. Webb, N. A. Woodhouse. *Advertising representative:* Thomas O. Woolf & Son, 70 E. Forty-fifth Street, New York 17, N. Y. Advertising rates and publication schedule sent on request.

"Check your air, Sir?"

Air compressor and tank are at right. Long cylinders on rack dry air before it enters cables.

He's checking the air pressure in a branch cable, one of scores serving a town. The readings along the cable are plotted as a graph to find low-pressure points which indicate a break in the protecting sheath.

Master meters keep watch over the various cable networks which leave a telephone office in all directions to serve a community. Air enters the system at 7 pounds pressure, but may drop to 2 pounds in outermost sections—still enough to keep dampness out.

To keep voices traveling strongly through telephone cables, you have to keep water *out*. This calls for speed in locating and repairing cable sheath leaks—a hard job where cable networks fork and branch to serve every neighborhood and street.

At Bell Telephone Laboratories, a team of mechanical and electrical engineers devised a way to fill a complex cable system with dry air under continuous pressure. Pressure readings at selected points detect cracks or holes, however small. Repairman can reach the spot before service is impaired.

It's another example of how Bell Laboratories works out ways to keep your telephone service reliable—and to keep down the cost to you.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in mechanical engineering

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THE BIGGEST THIEF
IN AMERICA

OAKITE GIVES YOU
THREE WAYS
TO FIGHT RUST

Day and night—wherever your steel is stored or handled—RUST, the biggest thief in America, is robbing you of production, robbing you of profit.

Oakite can help you defeat rust three ways:

★ **1. By removing rust from raw steel**—often eliminating a pickling operation by removing oil and rust at the same time.

★ **2. By preventing rust during processing**—protecting your steel during stamping, milling, machining or grinding—through finishing and assembling—all the way to shipping.

★ **3. By preventing under-coat rusting of painted products**—combining cleaning, paint-conditioning and rust prevention into one operation.

One department saves $1,000 a month

An enterprising foreman for a large Eastern manufacturer of precision steel parts kept a six-month record of the results of a special anti-rust campaign in his department.

After determining the saving of time formerly spent on re-processing rusted parts, he told the Oakite Technical Service Representative who had helped in the campaign: *"This saving has been over $1,000 a month."*

Today the company is intensifying the anti-rust campaign under the competent direction of that foreman—and is extending the campaign to other departments.

One of their chief weapons in stopping rust—during grinding, polishing, tumbling, assembly and other operations—is Oakite Special Protective Oil.

A 16-page illustrated booklet on *"How to prevent rust with Oakite Special Protective Oil"* is included in the FREE Oakite Anti-Rust Kit offered in the coupon.

FREE For the Oakite Anti-Rust Kit that tells about these three ways to stop RUST in your plant, just drop us a note or mail the coupon.

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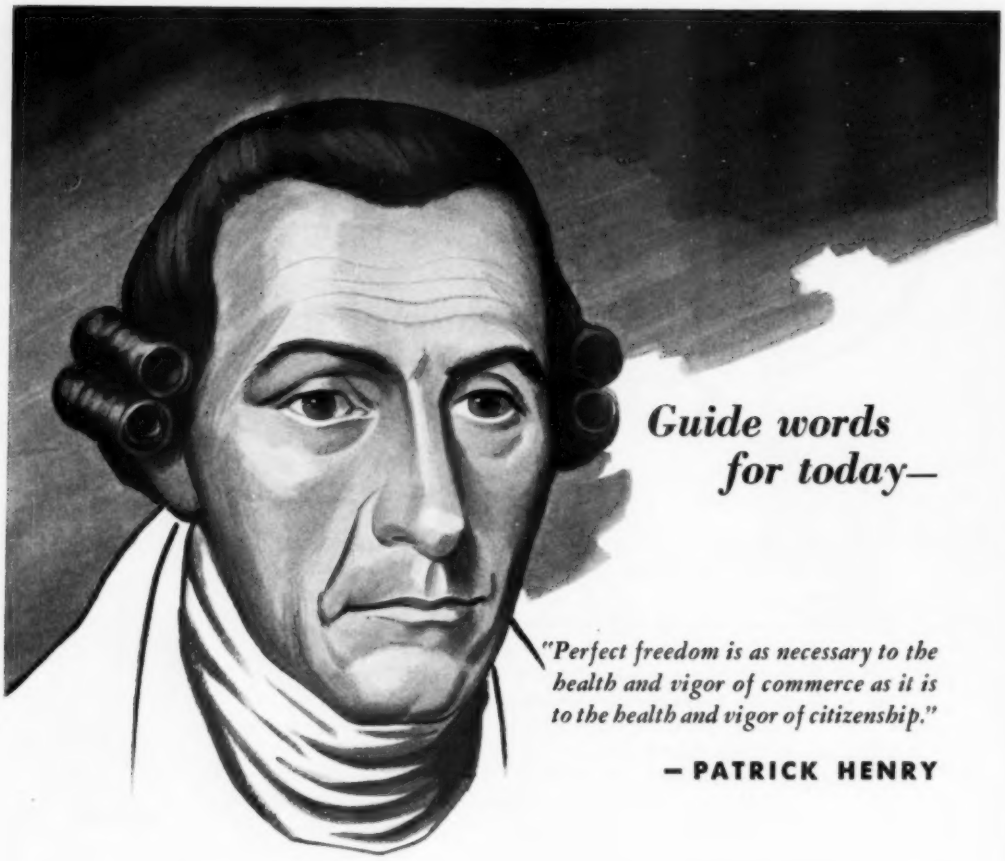

Guide words for today—

"Perfect freedom is as necessary to the health and vigor of commerce as it is to the health and vigor of citizenship."

— PATRICK HENRY

Patrick Henry had a precise understanding of freedom's meaning. "Perfect" freedom, whether for commerce or individuals, was not a license to harm others, or to disregard laws. It did include, however, the right to make decisions, to manage, to control one's affairs without undue government interference.

The health and vigor of America's citizenship and commerce are what made this nation great. But individuals are robbed of their self-reliance when they lean too heavily on government. And business concerns lose their vitality when bureaucratic regulations restrict their ability to plan imaginatively . . . and to execute those plans courageously.

"Perfect freedom" in its true sense is more important today than ever . . . as the entire free world looks to America for leadership and example in the fight against tyranny.

W B Stewart

President

DUTY HONOR COUNTRY

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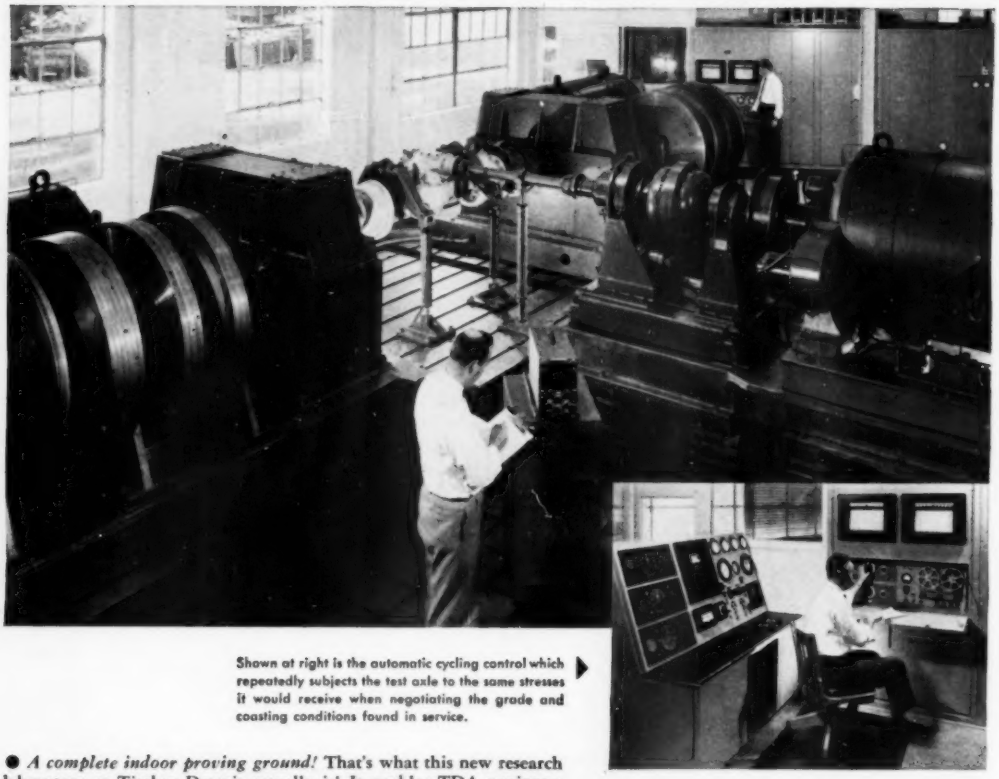
New Indoor Proving Ground Helps **TDA** Build The Truck Axles of Tomorrow!



Shown at right is the automatic cycling control which repeatedly subjects the test axle to the same stresses it would receive when negotiating the grade and coasting conditions found in service.

● *A complete indoor proving ground!* That's what this new research laboratory at Timken-Detroit actually is! It enables TDA engineers to test heavy-duty truck axles while simulating the same conditions encountered in the toughest on- or off-highway operation.

Incorporating the largest, most modern dynamometer equipment for testing driving axles, this new laboratory can reproduce truck axle torques and speeds, with the ability to repeat these tests accurately time after time by means of an electronic automatic cycling control. Shock loading tests can also be run which, up to now, have been impractical to reproduce under driving load.

Every time you build or buy a truck with TDA Axles, *you* reap the benefit of Timken-Detroit's long experience and modern facilities. When you see the name TDA on an axle you *know* it's the best-engineered truck axle built!

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A primary reason for the tremendous coverage of each Chrysler Siren is its 180 horsepower Chrysler V-8 Industrial Engine. This mighty power plant develops a terrific 400 mile per hour blast, sufficient to send 173 decibels of sound four miles in every direction from the rotating siren.

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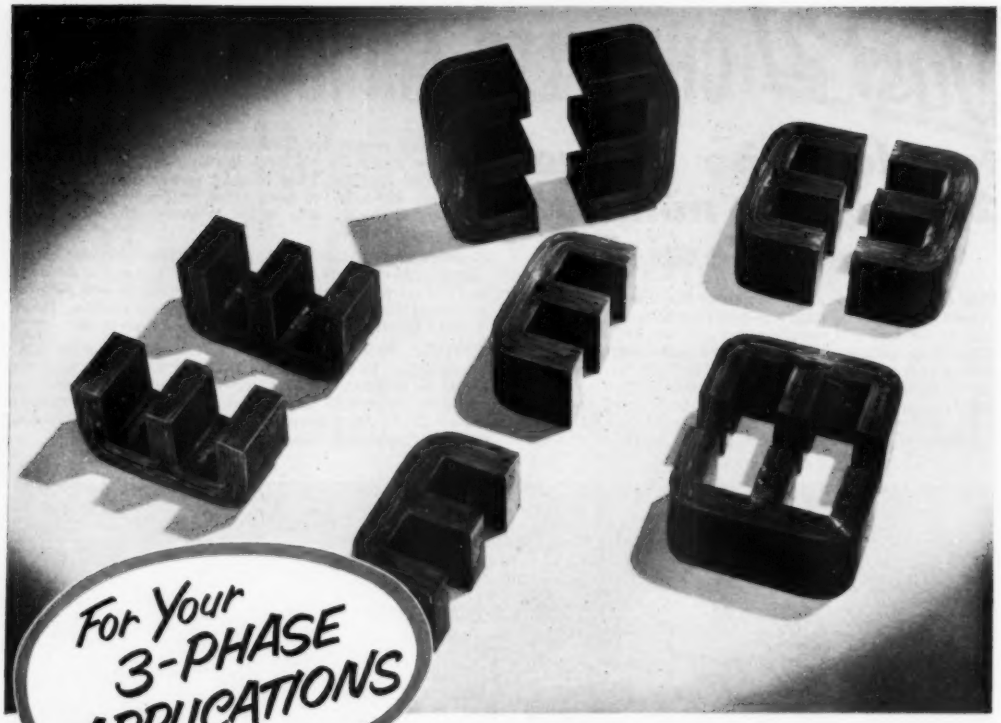
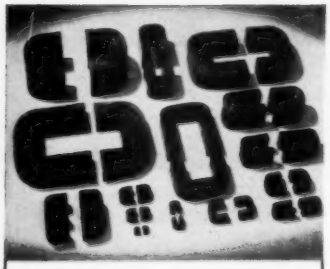
AIR RAID SIREN

Defense is a vital need, shared by all. Join and assist the Civil Defense group in your area.



Arnold E-CORES



C-Cores to meet any requirement

For your single-phase applications, Arnold "C"-Cores are available in any shape and quantity, and in any size from fractions of an ounce to hundreds of pounds . . . wound from Silectron strip in a wide range of ultra-thin and heavier gauges. (Sizes up to 10 lbs. in 12-mil strip; to any weight in thinner gauges.)

made from SILECTRON strip

(grain-oriented silicon steel)

The use of "E" cores, wound from grain-oriented silicon steel, results in weight and size reduction as well as higher efficiency and possible cost savings. "E" cores can be supplied in a variety of window sizes and core areas from 1, 2, 4 or 12-mil Silectron strip, for high or low frequency 3-phase applications. ● All Arnold cores are made by precision methods, and carefully tested under closely controlled conditions to assure highest quality and reliability. *We'll welcome your inquiries.*

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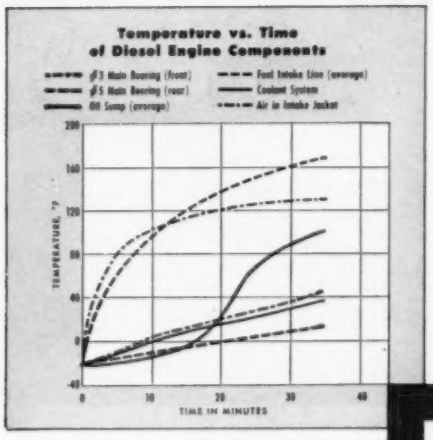

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South Wind's entirely new principle of scientific pre-heating has been developed, tested and proved in the field, as well as in the Stewart-Warner Laboratory Cold Room.

Here is a typical temperature record of critical engine components during pre-heating (only minimum capacity 70,000 BTU/hr. pre-heater kit used). This heat provided adequate temperature rise for easy starting—with less than 5 seconds' cranking.

Data is based on a 6-cylinder, 2-cycle, 225 HP Diesel engine weighing 3,000 pounds.

Engine Pre-Heating

Answers needs of all types of engines, all pre-heating requirements. Floods engine components, battery, crankcase, carburetor with warm, heated air. Makes starting easier, faster—*even at 65° below!*

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Warm air—independent of engine heat, independent of engine operation—circulates swiftly, evenly, to keep personnel comfortable at all times.

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3. Provides only clean, *dry* hot air to engine.
4. Permits use of optimum viscosity lubricants.
5. Normal lubrication at all times.
6. Lowers engine maintenance cost—prolongs engine life.
7. Reduces battery drain by reducing starting torque.
8. Reduces cost of starting aids.
9. Eliminates shock loads imposed by brute force starting methods.
10. Inhibits sludge formation and freeze-up of engine accessories.

Model 1030—30,000 BTU/hr. output.

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AT LAMBERT FIELD in St. Louis, a Caterpillar W20 Wagon, pulled by a Diesel DW20 Tractor, is loaded by a Lorain dragline powered by a Cat Diesel D13000 Engine. The wagon can handle 24 cu. yd. heaped. The 225-HP Cat Diesel Engine in the tractor and the 150-HP model in the dragline both operate at top efficiency on low-cost No. 2 furnace oil without danger of fouling.

Three big reasons

to standardize on Caterpillar

FIRST, every Caterpillar Diesel Engine, Electric Set, track-type and wheel Tractor, Motor Grader and Earthmover is a product of the finest research and engineering experience in the industry. This experience guarantees dependable, rough-and-ready performance on any kind of military assignment. It *always* makes sense to standardize on the best.

SECOND, your parts problem can be cut 'way down when you operate all-Caterpillar equipment. The powerful Cat Diesel Engines, for example, that power work boats, locomotives, compressors, draglines, tractors, motor graders and earthmovers have many parts that are interchangeable. And they all operate on one type of fuel—low-cost, non-premium fuel.

THIRD, your operators can do a more efficient job working with a single manufacturer's equipment. One operator, familiar with Caterpillar Diesel Engines, can run and maintain many different kinds of machines.

Military equipment has a tough job ahead of it. It must be reliable equipment, simple to operate and maintain. By standardizing on Caterpillar, you're sure your equipment gives back an honest return for the investment it represents.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CATERPILLAR

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TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

FROM the Bundy Sketchbook
TO jog a designer's imagination

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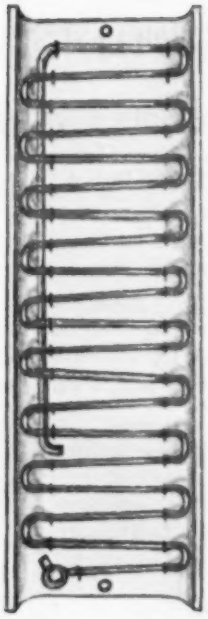

PLANT STAND FRAME

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REMARKS What's your tubing problem? Are competitors gaining an edge while you iron out design or fabrication kinks? Are unexpected tubing failures eating into profits? Skilled Bundy engineers can help solve that design or fabrication problem; save time, materials, money. And dependable Bundyweld Tubing will help eliminate those annoying, sometimes costly, failures.

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Leakproof
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Shock-resistant
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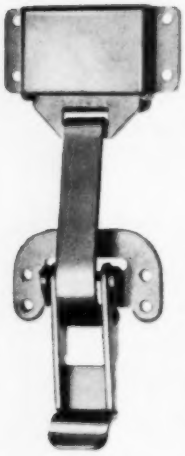
Have you a fastening or clamping problem?

IF YOU HAVE, CHANCES ARE BASSICK HAS A DEVICE TO SOLVE IT

Catches and fasteners, for everything from jeep hoods to tool boxes, kits, and containers, are available from Bassick . . . either "standard", like the four shown, or adaptations to meet your special needs by Bassick development engineers working with you.

For many years, Bassick has been a leading supplier of specialty hardware to the automotive and other top industries . . . in addition to being the world's largest manufacturer of casters.



Back View

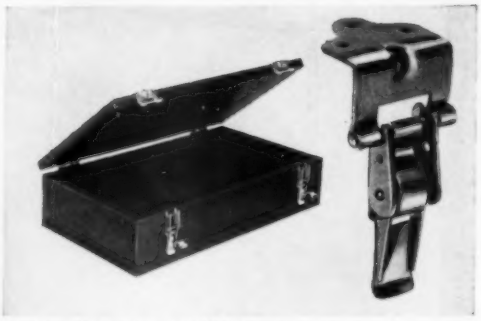
"Power-Pack" (ZLA-1104)

This behind-the-catch view shows why this clamp won't loosen even under the roughest handling or vibration. There are *100 lbs. of tension* compressed in these springs, but it is not a "knuckle breaker"! Ideal for operation in sub-zero temperatures.

Heavy-Duty Hood Fastener

(C-4017)

"Catching" vehicle hoods is but one of the many uses for this type of fastener. It always provides a dependable and economical "hold", yet allows easy access to encased units. Bassick makes many sizes and styles.



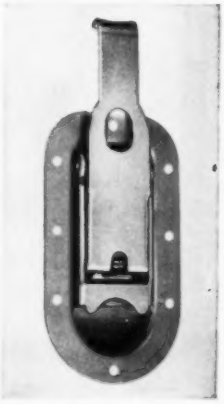
Combination Latch-Hinge (ZLA-1020, ZLA-1009)

A truly versatile fastener! Clamps on one side in locked position are acting as hinges, while the clamps on the other side are open, permitting entrance to the box, which can be opened from either side. Lid easily removed by unlocking all four fasteners.

Flush Type Clamp Assembly

(ZLA-1098)

These clamps are fully recessed to allow close stacking of the crates, boxes, etc., on which they're installed. Arm is spring-loaded to work easily and grip the latch firmly. Hole for inserting padlock or shipping seal.



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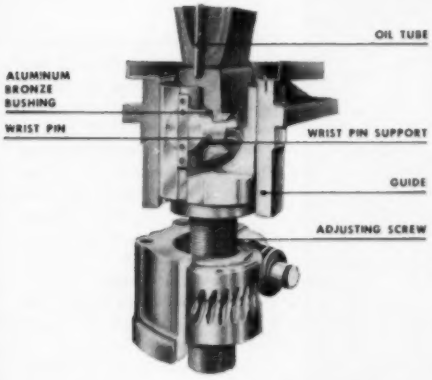
CONSTRUCTION



The Danly slide adjustment mechanism is typical of Danly precision construction. This cutaway view shows how the wrist pin is center supported to eliminate bending and how the entire upper assembly is retained within full length vertical guides, permitting closer, longer wearing machine fits at the wrist pin joint.

DANLY'S extra-rigid precision construction decreases deflection and assures slide alignment and accurate closure. Dies wear longer and can be built to closer tolerances . . . stamped parts stay within tight quality control limits for longer production runs at higher operating speeds . . . quality control is easier and less costly.

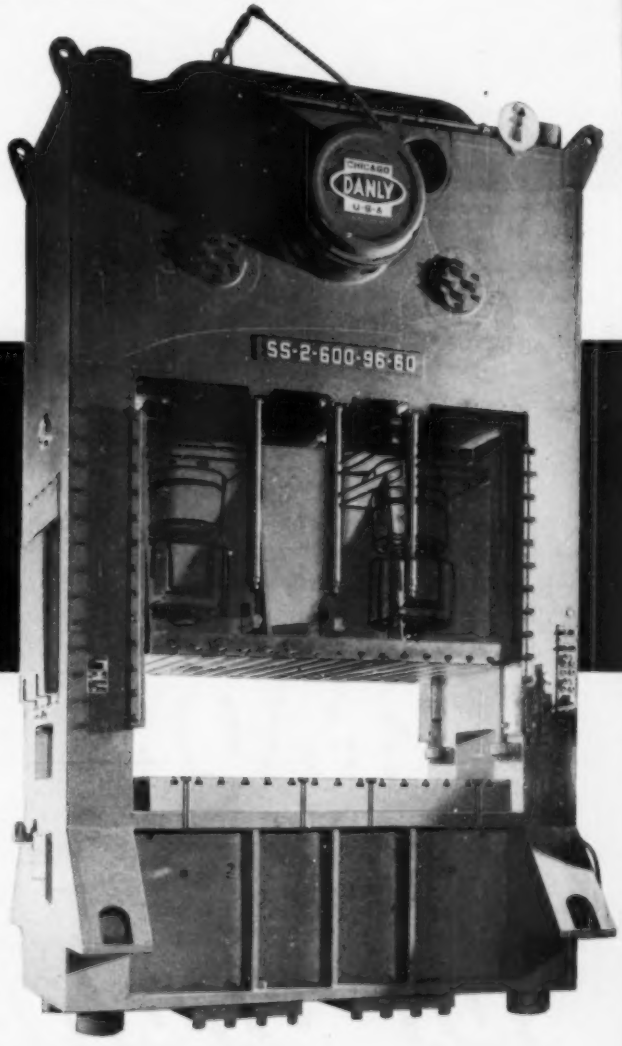
DANLY MACHINE SPECIALTIES, INC.

2100 South Laramie Avenue, Chicago 50, Illinois

DANLY

MECHANICAL PRESSES . . . 50 TO 3000 TONS

HYDRAULIC METALWORKING EQUIPMENT



View of Danly 600 ton Single Action Straight Side Press. Note extra-long oil lubricated gibs.

It costs less to run a DANLY PRESS!

Single Action Straight Side

Autofeed

Underdrive Single, Double, Triple Action

Gap Frame

Double Action Straight Side

FROM MINIATURES

This three ton tank was produced in 1918. It accommodated two men, a driver and a gunner sitting side by side. Armament consisted of one 0.30 caliber machine gun with arc of traverse 21 degrees, vertical arc, 38 degrees. Power to drive this unit was provided by two engines; 45 H.P. total. A planetary transmission having two forward speeds and one reverse was used. Maximum speed was 8 mph, and the fuel range was 34 miles. Dimensions were: length 13 ft., 8 in.; width 5 ft., 6 in.; height 5 ft., 3 in.

EVERY FACILITY
FOR PRODUCING

ARMOR PLATE for Ordnance . . . .

TO MONSTERS

Standard Steel Spring Company Has Always Been An Integral Part of Tank Production

Standard Steel Spring Company has served every National emergency since the inception of the tank in the capacity of key producer and coordinator for Ordnance Department armor plate programs. Today, more than ever before, our talents are devoted to the cause of speedy, efficient re-armament. To this end we have brought together a large, integrated group of subcontracting plants, staffed and equipped to turn out tank armor plate in huge volume. We work with our customers to design the parts for the most economical production, to efficiently tool for them, to expedite delivery and to carefully inspect so as to maintain exacting quality standards.

Our facilities are complete, our schedules flexible. Whatever your needs for flat or formed armor plate—fully machined and even sub-assembled if desired, we at Standard Steel Spring Company are ready to serve you.

Standard Steel Spring Company

ARMOR PLATE DIVISION • PENOBSCOT BLDG. • DETROIT, MICH.

• • Ready to Assemble in Gauges from ¼" to 4" inclusive

ECLIPSE-PIONEER "KNOW-HOW" PAYS OFF ON ORDNANCE VEHICLES

Based on original development work by Eclipse-Pioneer, a 24-volt electrical system has been made standard on all vehicles designed for Army Ordnance.

This system pays off in three important ways. First, it *saves critical space* because it's much more compact than the old 6- and 12-volt systems of comparable ratings. Second, it's *more readily serviced* since its component parts are interchangeable with those on often-available 24-volt aircraft equipment. Third, it's *more versatile* since its design is waterproof in accord with Army standards for submerged operation.

It was quite natural that Eclipse-Pioneer should take the lead in developing and manufacturing this more efficient electrical equipment. It was quite natural because Eclipse-Pioneer is unique in possessing the necessary "know-how" and production facilities, having acquired them in developing similar equipment for the aviation industry.

Among items now being produced by Eclipse-Pioneer for Ordnance are DC Generators, Generator Control Boxes, Starters, and Starter Relays. And other precision products for Ordnance application are now in advanced stages of development.

ECLIPSE-PIONEER DIVISION OF
TETERBORO, N. J.

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Bendix
AVIATION CORPORATION

with close-tolerance

ROCKRITE TUBING

In a Hamilton Standard hollow-steel aircraft propeller-blade, the core or spar provides most of the structural strength. It must also be dimensionally accurate to prevent vibration so that blades stay in balance during flight.

To achieve this vital accuracy, manufacture is started with seamless-tube high-alloy forgings, turned, bored and ground. These forgings are then compression-formed by the Rockrite process. This preserves their accuracy and results in a longer core-tube of tapered outside diameter and with a tapered wall.

If tubing accuracy is important in your ordnance production, investigate the advantages of Rockrite . . . the tubing that is sized by a distinctively different process. Write for Bulletin R2.

Cross-section of a Hamilton Standard hollow-steel propeller-blade showing the core, the shell and the synthetic rubber which fills the interior cavities.

ROCKRITE® TUBING

TR-188

TUBE REDUCING CORPORATION · WALLINGTON, NEW JERSEY

Specialized personnel . . .
facilities created especially for the purpose . . .
and an unduplicated background of experience in
research, design and production of military pyrotechnics . . .
these are among the reasons we have become
a leading prime contractor to the Armed Forces on
FLARE AND SIGNAL MUNITIONS
PHOTOFLASH MUNITIONS
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FOR AMMUNITION
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SHELL AND FUZE LOADING
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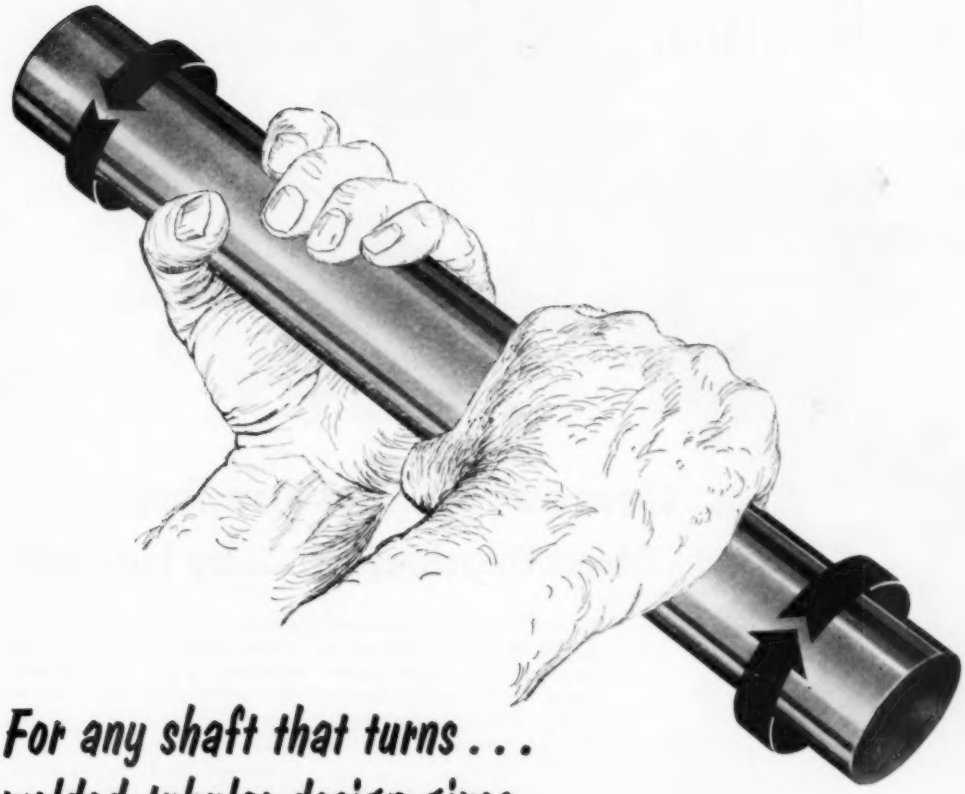
Inventors and Sole Manufacturers
of the Universally Accepted
SIGNAL (DISTRESS DAY AND NIGHT)
AN-MARK 13 MOD 0
The Standard Distress Signal
of the U.S. Armed Forces
AERIAL PRODUCTS, Inc.
ELKTON, MARYLAND



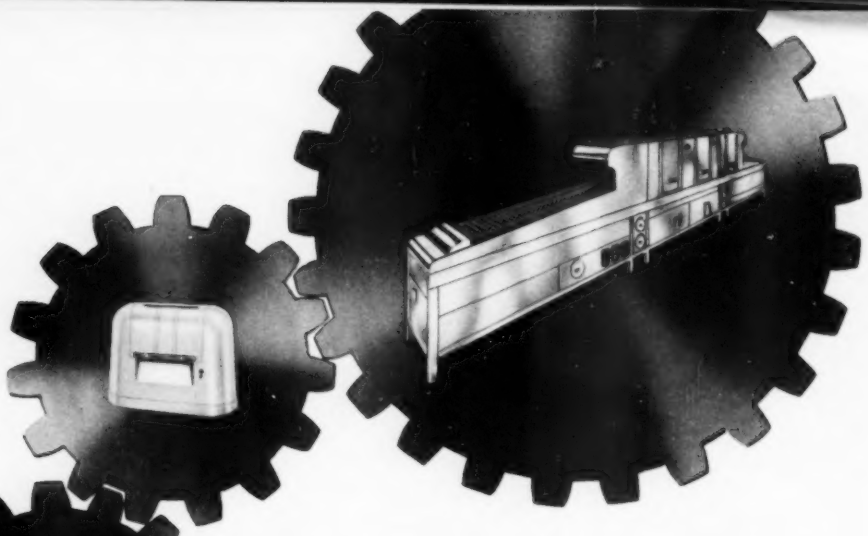
For any shaft that turns . . . welded tubular design gives the most strength at the least weight!

• Pound for pound, a tubular section will carry more torsional load than any other shape. This, plus ease of fabrication, accounts for the universal use of electric-welded steel tubing for automotive drive shafts, torque tubes, etc.

Investigate the economy and physical advantages of Brainard welded steel tubing for *your* products. Write Brainard Steel Division, Dept. EE-3, Griswold Street, Warren, Ohio. An integrated producer; offices throughout the U. S.

Brainard
SHARONSTEEL
STEEL DIVISION
SHARON STEEL CORPORATION

WELDED STEEL TUBING

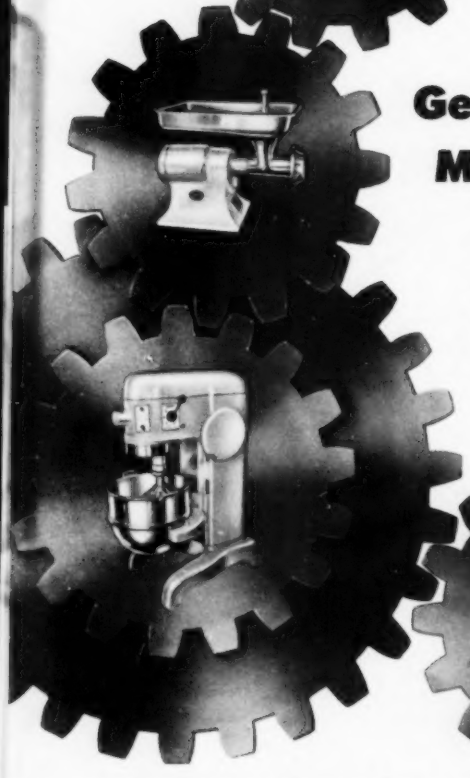


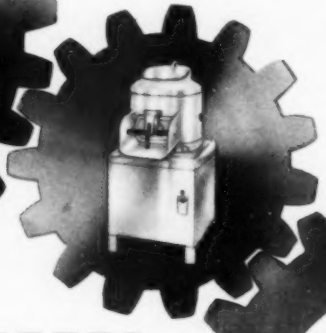
Geared for Mass Feeding... Mass Production...by Hobart

Gear your food preparation and dish handling with Hobart machines as you gear industrial output to production machines, and you get the same inevitable result—better quality, in less time, at lower cost. But in nutritious meals.

Every food, kitchen and dishwashing machine pictured here is a representative Hobart product—and only Hobart builds so many, each in a wide range of sizes and capacities, to standards acknowledged as unsurpassed in the industry for over half a century.

Are you planning a new group feeding operation? Want better performance in existing ones? Want to consolidate planning, purchasing and service for one machine or an entire installation? Check on Hobart with the Hobart representation in your city. Or write . . . ***The Hobart Manufacturing Co., Troy, Ohio.***





THE HOBART MANUFACTURING COMPANY, Troy, Ohio
Attention: **DEPT. ADV.**

☐ Please send me full information on the complete Hobart line of ☐ Food Machines ☐ Kitchen Machines ☐ Dishwashing Machines

☐ Please have local representative call on me.

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Trademark of Quality Hobart for over 50 years

Hobart
Food Machines

The World's Largest Manufacturer of Food and Kitchen Machines

Remington Rand Methods News

A 20% increase in productivity with visual scheduling

An aluminum fabricating plant wanted to apply the Gantt principle of charting work done against work planned. After a study, they chose Sched-U-Graph boards as the most rational and simple device for charting daily progress of each item, part and sub-assembly on defense and civilian orders.

Their experience shows many definite advantages flowing out of this visible method for production scheduling. The big, bold charts make it easy for everybody to grasp all significant facts on machine loading, scheduled future loading, each variation from schedule, and the movement of each work order by operation.

Also, the Personnel Department can now *see clearly* how many employees will be needed – and when – in each productive department. The Sales Department can advise a customer well ahead of time if a schedule will not be met exactly. The Production Engineer can determine hours each machine has been used as well as scheduled future use – for efficient planning of his preventive maintenance work and replacement of equipment.

The most important advantage, of course, is that of insuring a continuous production flow through quick spotting of any bottlenecks which may cause serious delays. Production officials of the plant conservatively estimate that a 20 per cent increase in productivity is effected by this Sched-U-Graph visible method. For more details, see our scheduling manual **KD-341.**

CAN YOUR PURCHASING DEPARTMENT DO MORE TO HELP PRODUCTION?

There's a new way to increase the effectiveness of purchasing records. It's a simple checklist to help the buyer get complete information without burdensome detail. Checking it over just once with care may point the way to more efficient procurement of materials and equipment for your production needs.

This checklist is just one of the valuable features in a new 20-page manual of purchasing procedures to save time and money. It's full of practical ideas which will be easy to apply in your purchasing office.

You'll find here plenty of case histories showing how other firms help buyers make sound decisions faster, get orders placed and delivered sooner, slash purchasing paperwork, give clerks more responsibility, reduce the number of items to be purchased, etc.

Also, you'll see the actual forms and methods used in many firms – for every phase of paperwork from receipt of the requisition to closing of the order file. Ask for your copy of this new purchasing procedures manual **X-1202.**

A pressure problem for engineers, and how it was solved

The teletypes pounded urgently. Air Force officials wanted to know by 6:00 P.M. if a new alloy could be substituted in building the giant C-124 Globemaster transport.

The engineering chief of this division scanned the teletype, hurriedly made notes on its contents, dispatched the original to the typing pool. Minutes later, 20 neat copies of the message were placed on the desks of sub-chiefs concerned. This plant gets *fast action* from its Electri-conomy typing pool. Their all-electric typewriters, equipped with a special type face for legibility, can produce up to 20 neat copies from a single typing.

Electri-conomy helps relieve pressures on Engineering in many other ways, too. On big jobs such as bills of materials, parts catalogs and price lists, many typists can work simultaneously yet with uniform "touch" for uniform readability from page to page. This is especially important when material must be reproduced by stencil, offset or photographic means.

Regular work such as engineering changes, orders and reports is also turned out faster because this electric typing method requires less effort, reduces fatigue. Electri-conomy also reduces turnover in the typing pool. For details, see our engineering case history **RE-8548A** and folder **RE-8356.**

The case of the unpopular punch press

When a well-known manufacturer of engine parts switched to Remington Rand punched-card costing, the new detailed reports revealed surprising doings in the shop.

For instance, one report indicated a certain type of punch press was the most efficient on a particular operation. But another report showed the press was not often used on this operation. Investigation revealed that workers preferred a different type of press which was easier to operate. Management now had all the facts needed for effective action.

What's more, this new system put the finger on profit leaks much faster. Instead of waiting 30 days to get sketchy facts, management now gets complete cost reports 5 days after completion of a job.

Naturally, costing is just part of the punched-card accounting operation which helps the firm produce better products at lower cost with better service to customers.

Let us show you how it also simplifies control of parts inventory, scheduling production for warehouse stocks, and writing payrolls. Ask for case history folder **SN-752.**

If you'd be interested in punched-card services to give you the same informative records without the need of setting up your own punched-card department, ask for our folder **BSD-6.**

Management Controls Reference Library
Room 1766, 315 Fourth Ave., New York 10

Please circle the literature you desire:

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X-1202 RE-8356 RE-8548A

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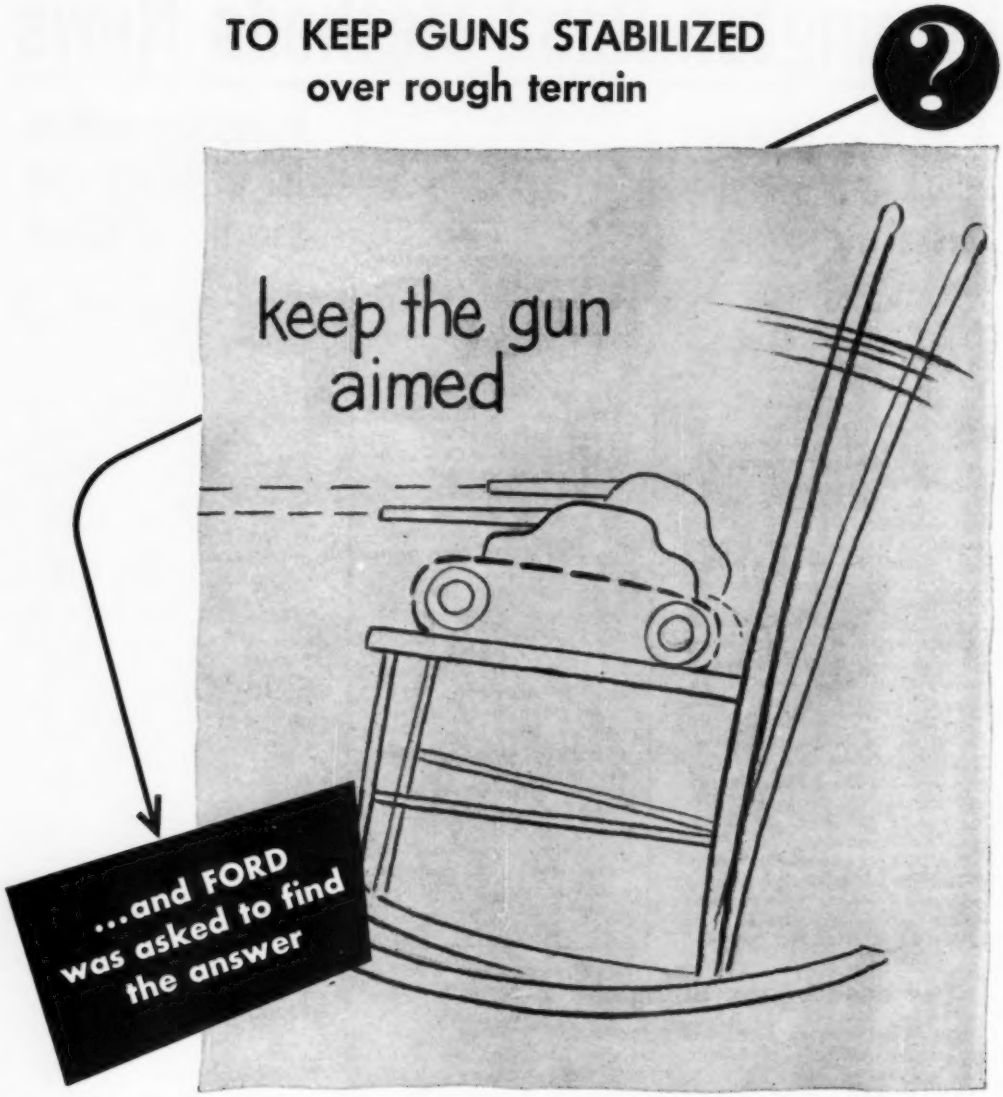
City_____

P-10

Remington Rand

operators of the Louisiana Ordnance Plant

TO KEEP GUNS STABILIZED
over rough terrain



Over open area a tank pitches and heaves like a rocking chair . . . but regardless of the bumps . . . ditches . . . hills . . . the guns keep pointing at the target while the tank is moving. Ford Instrument Company played a vital role in designing and manufacturing a stabilizer unit for the tank's gun fire control system.

This is typical of the problems that Ford has solved since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic electro-mechanical, magnetic and electronic instruments that bring us our "tomorrow" today. Control problems of both Industry and the Military are Ford specialties.

You can see why a job with Ford Instrument Company offers a challenge to young engineers. If you qualify, there may be a spot for you in automatic control development at Ford. Write for illustrated brochure.

7

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

CONTINENTAL MOTORS
Powerful as the Nation
AMERICA'S STANDARD

TRANSPORTATION GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N4062	4	2⅛	3½	62	26 @ 3400 RPM
Y4069	4	2½	3½	69	28 @ 3400 RPM
Y4091	4	2⅞	3½	91	36 @ 3400 RPM
F4124	4	3	4½	124	47 @ 3200 RPM
F4140	4	3⅛	4½	140	52 @ 3200 RPM
F4162	4	3⅜	4½	162	58 @ 3200 RPM
F6186	6	3	4½	186	77 @ 3500 RPM
F6209	6	3⅛	4½	209	90 @ 3500 RPM
F6226	6	3⅛	4½	226	99 @ 3500 RPM
M6271	6	3⅛	4½	271	97 @ 3000 RPM
M6290	6	3⅛	4½	290	108 @ 3000 RPM
M6330	6	4	4½	330	125 @ 3000 RPM
K6271	6	3⅛	4½	271	115 @ 3200 RPM
K6290	6	3⅛	4½	290	123 @ 3200 RPM
K6330	6	4	4½	330	145 @ 3200 RPM
B6371	6	4⅛	4½	371	124 @ 3000 RPM
B6427	6	4⅛	4½	427	142 @ 3000 RPM
T6371	6	4⅛	4½	371	144 @ 3000 RPM
T6427	6	4⅛	4½	427	166 @ 3000 RPM
U6501	6	4½	5⅛	501	178 @ 2600 RPM
R6513	6	4½	5½	513	180 @ 2800 RPM
R6572	6	4¼	5½	572	200 @ 2800 RPM
R6602	6	4⅜	5½	602	212 @ 2800 RPM
S6749	6	5⅛	5½	749	250 @ 2800 RPM
S6820	6	5⅜	5½	820	277 @ 2800 RPM

TRANSPORTATION DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
TD6427	6	4⅛	4⅛	427	116 @ 2400 RPM
RD6572	6	4¼	5½	572	156 @ 2200 RPM
SD6802	6	5⅛	5½	802	218 @ 2200 RPM

Cut Hauling Costs ...with Specialized RED SEAL POWER

No matter what your hauling job, it's wise to choose a vehicle with a Red Seal under the hood. In that way, you get the benefit of truly specialized power, for there's a Red Seal engineered to the needs of every transport job. Continental builds 25 different gasoline models, from 26 to 277 h.p.—plus three Cushioned Power Diesels with bare engine horsepower ratings of 116, 156 and 218—all for transportation use. For lowest ton-mile costs throughout the life of the vehicle, choose a make with Continental Red Seal. Save, too, by replacing old engines in present equipment with the right Red Seal from the accompanying list.

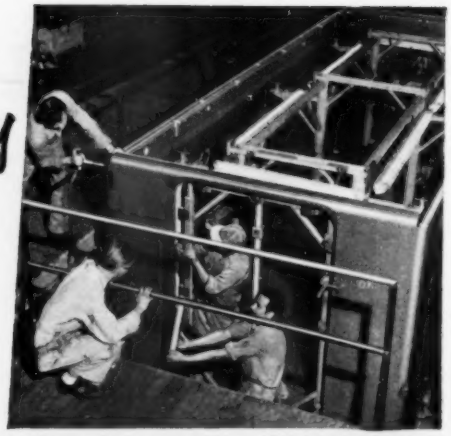
PARTS AND SERVICE EVERYWHERE

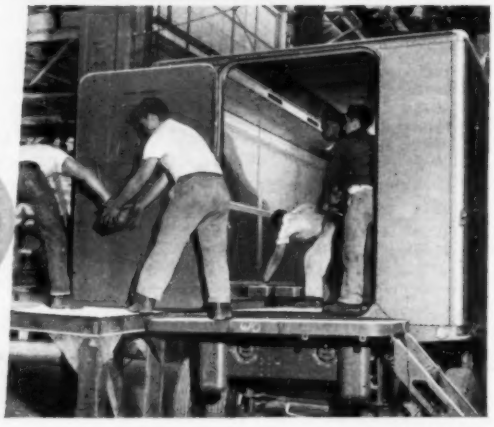
Continental Motors Corporation
MUSKEGON, MICHIGAN

FRUEHAUF

Cooperates with Douglas

TO SPEED PRODUCTION ON ANTI-AIRCRAFT FIRE-CONTROL TRAILERS!





MAGNESIUM TRAILERS designed to house and transport a new and more effective fire-control system for automatically aiming anti-aircraft artillery are being built now by Fruehauf Trailer Company. Unusually lightweight, Fruehauf's fire-control Trailers can be transported readily by plane.

The new fire-control system is an outgrowth of the famous World War II electrical gun director and its associated radar systems which proved effective against Nazi planes and "buzz bombs." Today's system operates on the same principle as its predecessor, but many improvements have been incorporated.

These new military units constitute an excellent example of Fruehauf's co-operation with prime-contractors in producing defense units. Fruehauf's extensive and versatile production facilities, including seven large manufacturing plants, and Fruehauf's complete engineering services, are available for defense sub-contract jobs of all kinds, at all times.

World's Largest Builders of Truck-Trailers

FRUEHAUF TRAILER COMPANY

DETROIT 32, MICHIGAN

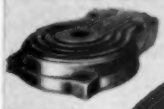
FRUEHAUF Trailers

"ENGINEERED TRANSPORTATION"

TRUCK-TRAILERS FOR EVERY CIVILIAN AND DEFENSE HAULING NEED!

SPECIALISTS IN METAL STAMPINGS

FOR OVER 70 YEARS



Base For Power Lawn Mower

G.P.&F.®

Solenoid Cover U.S. Navy

Aerial Delivery Container U.S. Air Force

Radio Case—U.S. Signal Corps

means...

Greater Production Facilities

... for your requirements of deep-drawn and stamped metal parts

Over 1000 skilled people ... 289 deep draw and stamping presses ... 92 welding machines ... 15 acres of production facilities ... complete tool and die department.

Washing Machine Tub

Scale Platter

Safety Guard for Power Tools

Vacuum Cleaner Parts

STAMPING • DRAWING • FORMING
TINNING • GALVANIZING • WELDING
LEAD COATING • SPRAY FINISHING
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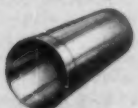


Longhorn Cheese Mold

Commercial Fruit Juicer

Deep Fat Fryer Pot

Transmitter Case

Fuel Tank

Gas and Water Cans U.S. Quartermaster

Cover for Ice Cream Freezing Equipment

Christmas Tree Stand

G.P.&F. SINCE 1880 MILWAUKEE

GEUDER, PAESCHKE & FREY CO.

1327 W. ST. PAUL AVENUE • MILWAUKEE 1, WISCONSIN

One DEMPSTER-DUMPSTER Serves Scores of Containers . . All Designs . . . All Sizes . .

Handling Materials of Almost Every Description at the Lowest Possible Cost!

One Dempster-Dumpster mounted on one of your trucks serves any required number of big detachable Dempster-Dumpster Containers spotted at convenient materials accumulation points inside and outside your buildings. The capacity of these containers range up to four times greater than the average dump truck body. They are built in a wide variety of designs best suited to the materials handled—be they solid, liquid or dust . . . trash or rubbish . . . bulky light or heavy. The truck-mounted Dempster-Dumpster, with only one man, the driver, picks up one pre-loaded container after another, hauls it to destination where materials are dumped or load set down intact. The Dempster-Dumpster may handle raw materials on one haul, liquids on another, trash and rubbish on another, etc. It's like having one truck with 15, 25, 65 or 100 different bodies.

This is the *Dempster-Dumpster System*—the modern method of bulk materials handling. It is saving thousands of dollars annually for hundreds of plants in every type of industry because it: Eliminates 3 to 5 conventional trucks and crews—reducing cost of truck equipment and operation accordingly. . . Eliminates standing idle time of trucks and crews. . . Eliminates re-handling of materials. . . Increases efficiency, sanitation and good housekeeping.

The *Dempster-Dumpster System* is, without question, the most efficient method of materials handling by truck ever devised! More efficient and lower cost materials handling in your plant may be simply a matter of getting the minds of your engineers and ours together. Write us now. The *Dempster-Dumpster System* is manufactured exclusively by Dempster Brothers, Inc.

WHEN A CONTAINER is full, the Dempster-Dumpster picks it up, hauls it to destination and dumps the materials or sets the load down intact. These three simple operations, shown above, are hydraulically controlled by driver in truck cab.

DEMPSTER BROTHERS, 933 Shea Building, Knoxville 17, Tennessee

Selected to carry AMMUNITION *for U. S. Navy*

THIS IS BALANCED SUSPENSION. (1) U-shaped, pendulum-type hangers permit shock-absorbing lateral motion. (2) Chrysler Design self-contained, constant friction snubbers work with (3) the longest travel standard coil springs to absorb vertical shocks and control spring oscillation.

Chrysler Design RAILROAD FREIGHT TRUCKS

offer *better protection* to all goods in rail transit

Already in wide use by railroads and shippers, now Chrysler Design Freight Car Trucks have been specified by the U. S. Navy for the delicate job of carrying ammunition and explosives.

Chrysler Design trucks are constructed on a completely new application of the fundamental principles of *Balanced Suspension*. They show reductions of 98% in vertical shock index and 95% in lateral shock index (AAR formula), as compared with standard trucks having coil-snubber spring groups. Users report they virtually eliminate rail-originated damage to lading. Low maintenance costs have been proven in a combined total of over 40 million car miles of accelerated freight and head-end service.

These advantages are finding profitable use in such developments as the new General American-Evans' Damage-Free Box Car, where Chrysler Design trucks are standard equipment . . . as well as in all other types of railroad freight and head-end passenger train service. To railroads and shippers, they offer the prospect of a new day of faster, more economical rail freight.

One of 888 U. S. Navy ammunition cars equipped with Chrysler Design trucks and built by Pullman-Standard, Chicago

This development of Chrysler Design Railroad Freight Trucks is a natural outgrowth of Chrysler research on the fundamentals of vehicle suspension. Such work is part of Chrysler Corporation's continuous research into every phase of vehicle design. The value of this same research is reflected in the superior riding qualities of Chrysler-built cars and trucks.

Chrysler Design Railroad Freight Car Trucks are manufactured and sold by The Symington-Gould Corporation, Depew, N. Y., under Chrysler license. Chrysler Design Friction Snubbers are manufactured and sold under Chrysler license by the Houdaille-Hershey Corporation, Detroit 2, Mich.

CHRYSLER CORPORATION

Plymouth • Dodge • De Soto • Chrysler

When you buy TROLLEY CONVEYORS . . .

LINK-BELT GIVES YOU BOTH!

Superior components → plus engineering ingenuity

Effective sealing of wheel and bracket keeps out dust and dirt
Wheels are drop-forged and internally machined to extremely close tolerances
Raceways are induction hardened. High load capacity is based on entire assembly — not just on bearing
Rugged, one-piece bracket and clevis are drop-forged and heat-treated—fewer parts to maintain
Trolley can replace other makes without disturbing chain's operating position
Clevis pins are locked in bracket, cannot rotate. Bracket wear is minimized

These heavy shells have ridden through a paint spray booth and are now drying on a Link-Belt Trolley Conveyor.

This Link-Belt Overhead Trolley Conveyor conveniently delivers 90-mm. shells along their finish-turn production line.

Shells travel in large quantities over long distances upon this Truck-Tow adaptation of an overhead trolley conveyor.

Travel up, down and around at synchronized speeds. Straight-line production regardless of physical layout. Saving of floor space. Release of manpower for productive jobs.

You get all these outstanding production advantages with any well-engineered overhead trolley conveyor. But you get more—much more—when you specify Link-Belt.

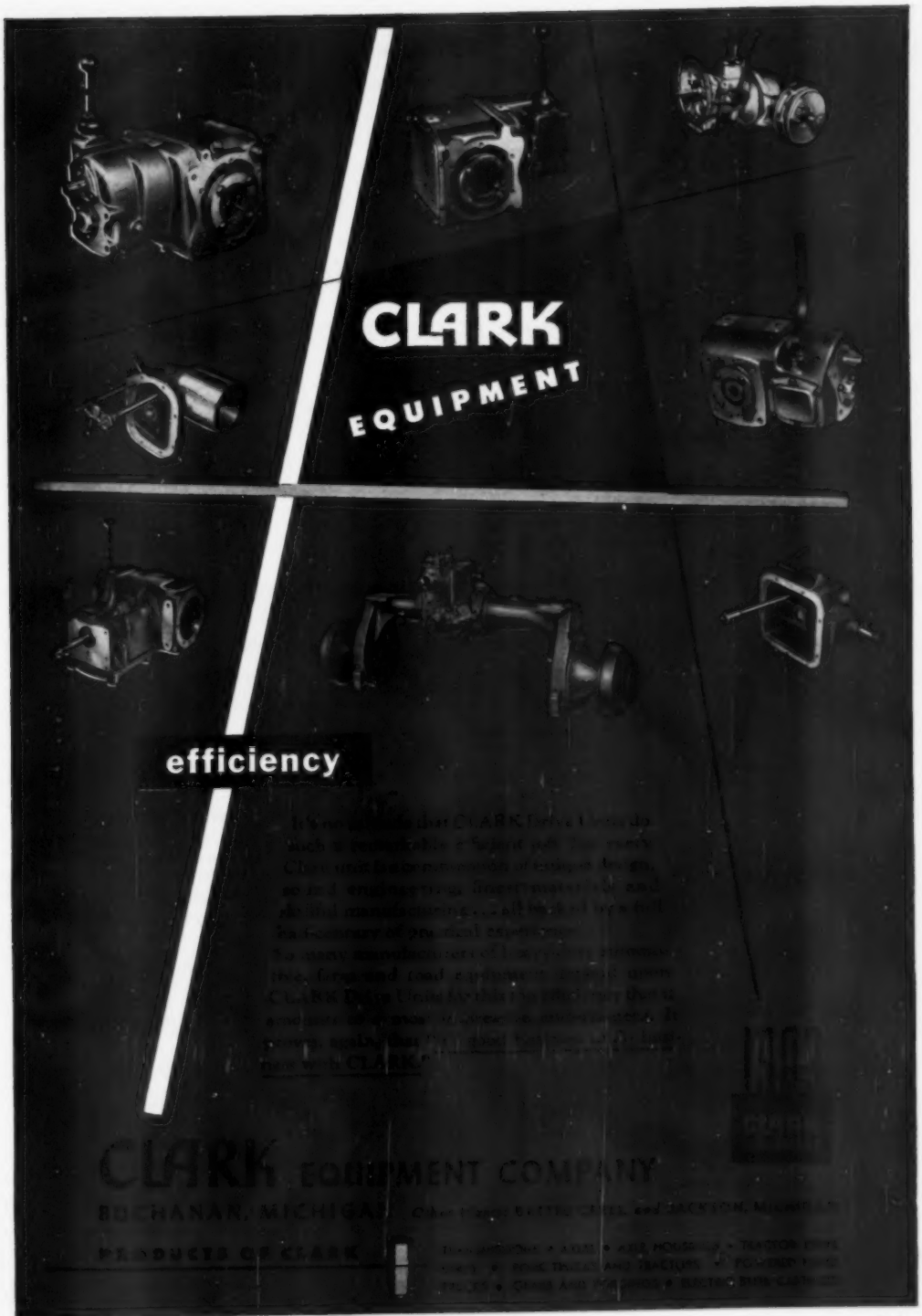
Not only does Link-Belt make the most popular, the most advanced trolley on the market—you also tap industry's greatest source of materials handling and power transmission experience.

Put quality manufacture plus engineering ingenuity to work for you. Our specialists will work with you and your consultants . . . help you set up smooth, steady, straight-line production in your plant.

LINK-BELT

OVERHEAD TROLLEY CONVEYORS

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,305-A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BUCHANAN, MICHIGAN
PRODUCERS OF CLARK

How to find Fast Answers to metal finishing problems

Consult the Company that helps with all these finishes:

. . . plated . . . organic . . . conversion coatings

UNITED CHROMIUM offers you unusual cooperation on surface finishing problems. Unusual, because this aid is not limited to one type of finish. It covers metallic and organic coating systems, both decorative and functional. The service rendered in the application of Unichrome products for ordnance and civilian goods finishing is based on 25 years' experience in the field.

Such specialized yet extensive knowledge of coating systems and how to apply them can help you speed up selection of the right finish on your product, improve results or reduce costs. To illustrate:

ONE PRIMER FOR MANY DIFFERENT REQUIREMENTS

Test panels and users' records show that Unichrome Primer AP-10 combines many properties not usually obtainable in a single priming material. For instance: It can be used either as an air-dry or baking type primer. It dries fast. Its adhesion equals that of standard primers on steel – surpasses them when applied to light metals. Furthermore, it is applicable to different materials, including magnesium, aluminum, zinc, tin, cadmium, iron, steel, copper – even glass. Here, then, is virtually a multi-purpose primer to reduce the need for storing a variety of individual types.

THE RIGHT FINISH FOR CHROMATE-TREATING TO SPECIFICATIONS

United Chromium offers the widest choice of chromate finishes through its Unichrome Dip and Anozinc* processes. The first operates by straight chemical conversion. The Anozinc process, like anodizing, uses electric current. Both have cost-cutting advantages for certain types of production and both produce a variety of finishes. If you need a chromate finish, you're bound to find in this wide group the one that's "just right" – right for the product, the Government specifications, and for your own production needs.

*Trade Mark

REAL GAINS IN CHROMIUM PLATING PRODUCTION

Service records keep confirming the production advantages of the Unichrome S.R.H.S. Chromium Bath. Two typical cases: An aircraft supplier plates steel bushings in 2½ to 3 hours with this bath, instead of 6 hours required in the ordinary bath. And the plate is smoother, reducing polishing time, too. Another concern doubled production of plated machine tool parts when it switched to Unichrome S.R.H.S. Bath.

UNICHROME Trade Mark **COATINGS for METALS**

UNITED CHROMIUM, INCORPORATED 100 East 42nd St., New York 17, N. Y.

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.

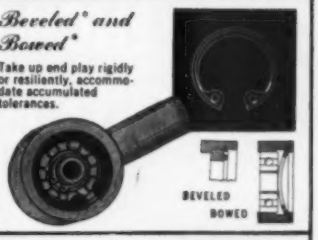
Speed Production, save material and machining operations with Waldes Truarc Retaining Rings

better way to hold parts together

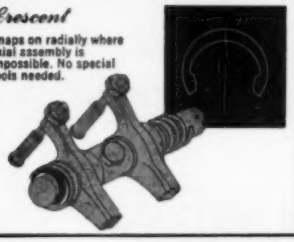
THERE'S A TRUARC RING FOR EVERY PURPOSE

Standard* — Forms secure shoulder for tight pressure fit when installed in groove.

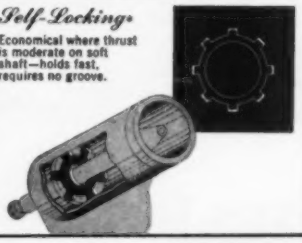
Beveled* and Bowed* — Take up end play rigidly or resiliently, accommodate accumulated tolerances.



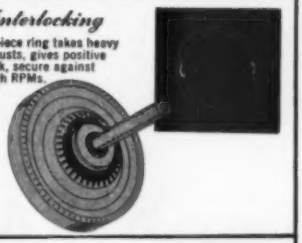
Crescent — Snaps on radially where axial assembly is impossible. No special tools needed.



Self-Locking* — Economical where thrust is moderate on soft shaft—holds fast, requires no groove.

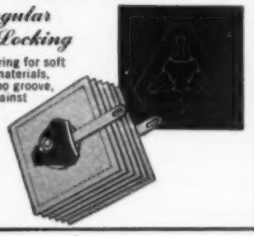


Interlocking — 2-piece ring takes heavy thrusts, gives positive lock, secure against high RPMs.



Inverted* — Provides uniform shoulder for curved abutting surfaces, for bearings with large corner radii.

Triangular Self-Locking — Low cost ring for soft shafting materials, requires no groove, secure against vibration.



E-Ring — Provides large strong shoulder for small shaft. Applied radially.

*BOTH INTERNAL AND EXTERNAL TYPES AVAILABLE

Thousands of smart manufacturers are *stepping up* production, while actually *cutting* costs—with Waldes Truarc Retaining Rings! Truarc Rings simplify your designs. The ease with which they can be assembled and disassembled makes them superior in many fastening applications where machined shoulders, nuts, bolts, snap rings or cotter pins have been used.

Waldes Truarc Rings eliminate threading, milling and other skilled labor operations... save on material. And there's a Truarc Ring for every purpose... precision-engineered to conform to the highest NAS and SAE standards!

Waldes Truarc Rings are nationally distributed and stocked. Send us your drawings. Waldes Truarc engineers will give your problem individual attention, without obligation.

WALDES TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

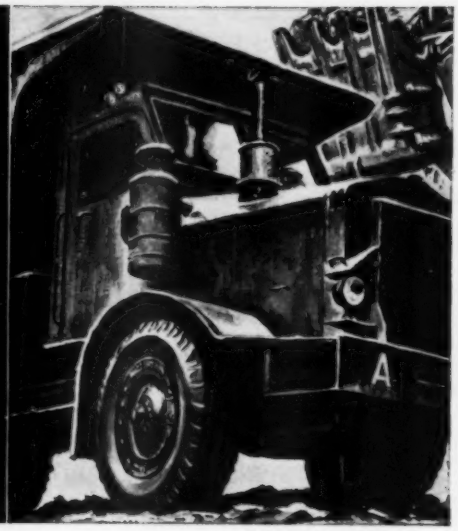
WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 2,362,947; 2,362,948; 2,416,052; 2,420,921; 2,420,341; 2,420,785; 2,441,848; 2,455,165; 2,483,390; 2,483,383; 2,487,902; 2,487,903; 2,491,306; 2,500,091 AND OTHER PATENTS PENDING.

SUB-CONTRACTING FACILITIES AVAILABLE

The same precision production facilities which have turned out millions of Truarc Rings to the most exacting specifications are available to handle sub-contracting of metal stampings. Write directly to Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N.Y.

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, N. Y. • MAKERS OF FAMOUS, PRECISION-ENGINEERED WALDES SLIDE FASTENERS AND SNAP FASTENERS

You Can Extend Life of ENGINES, TRANSMISSIONS and DIFFERENTIALS



With Allison Torqmatic Drives

BASED on user records, heavy-duty trucks equipped with Allison TORQMATIC CONVERTERS and TRANSMISSIONS *last longer and cost less to operate* than trucks with mechanical drives.

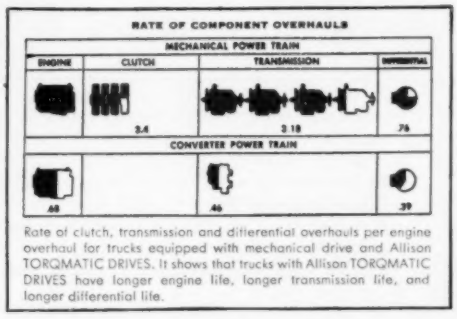
Records show that Allison TORQMATIC DRIVES boost truck availability, enabling operators to improve their schedules and, thus, they can do more business.

Trucks — and other heavy equipment — with Allison TORQMATIC DRIVES use the flexibility of the converter to start heavy loads and make shock-free gear shifts at full power. The Allison TORQMATIC DRIVES automatically balance engine power with the load requirement. This automatic operation makes the driver's job easier and reduces wear on the whole unit—thus cutting maintenance cost.

You are interested! Attach this advertisement to your letterhead and send it to Allison. You will receive detailed evidence on what these Allison TORQMATIC DRIVES will do for you.

And the next time you're ordering heavy-duty equipment, you'll ask your dealer or manufacturer for units with Allison TORQMATIC DRIVES.

ALLISON *Division of* GENERAL MOTORS
894-00 Indianapolis 6, Indiana

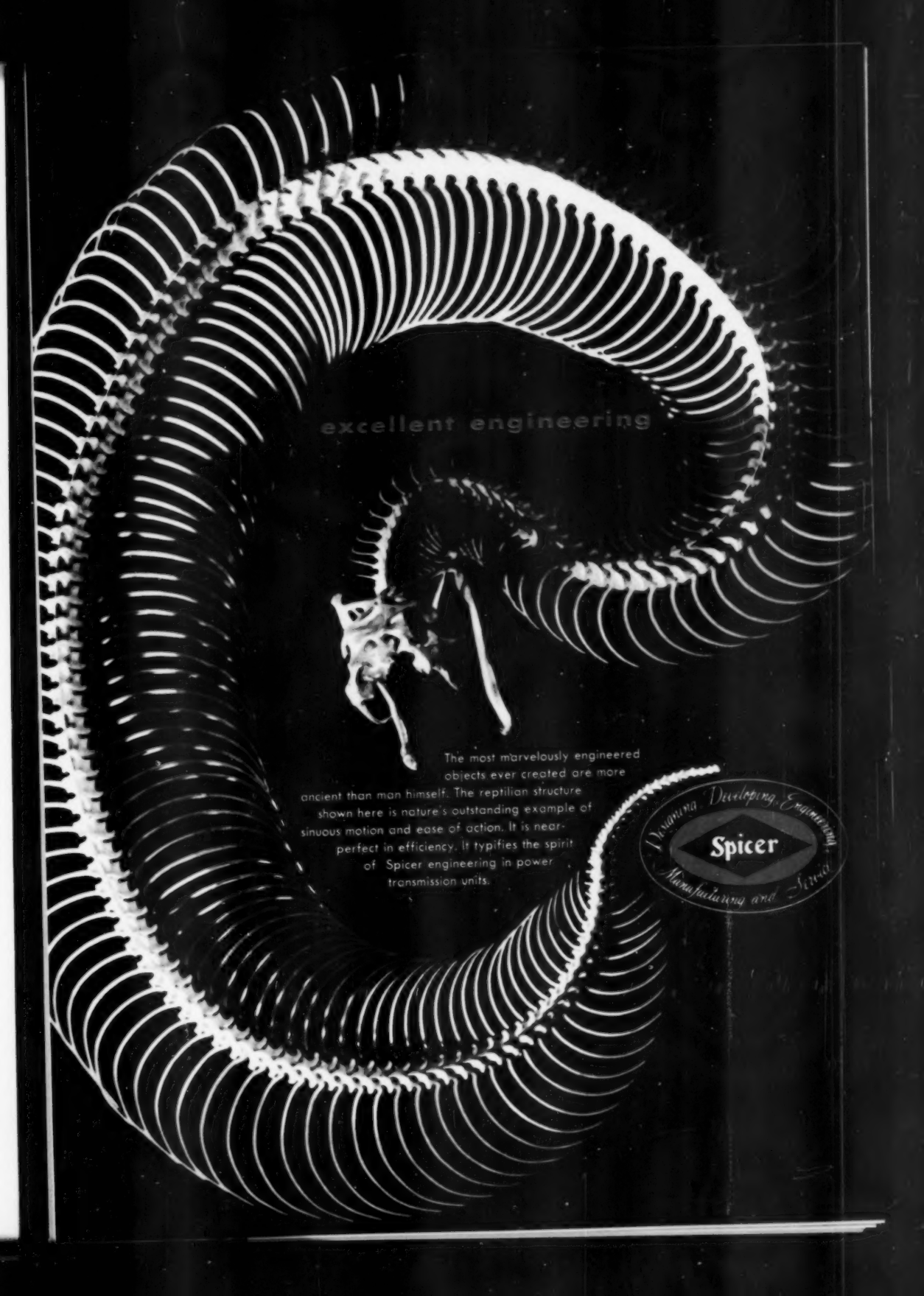


Rate of clutch, transmission and differential overhauls per engine overhaul for trucks equipped with mechanical drive and Allison TORQMATIC DRIVES. It shows that trucks with Allison TORQMATIC DRIVES have longer engine life, longer transmission life, and longer differential life.

MATCHED UNITS BUILT BY ONE MANUFACTURER

Allison TORQMATIC DRIVES

COMPACT, EFFICIENT HYDRAULIC DRIVE FOR TRUCKS * CRANES * TRACTORS * SHOVELS * DRILLING RIGS

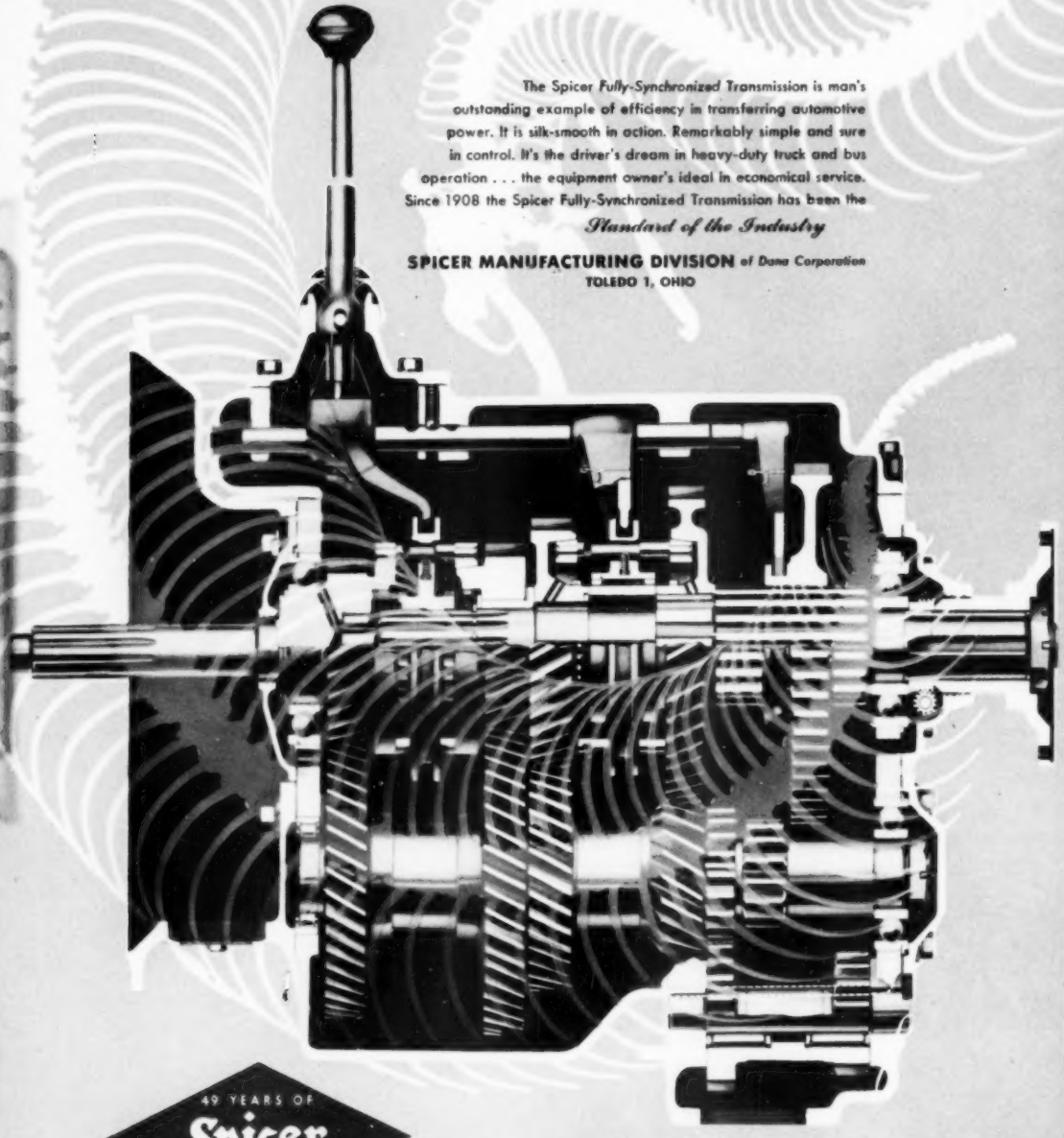

excellent engineering
The most marvelously engineered objects ever created are more ancient than man himself. The reptilian structure shown here is nature's outstanding example of sinuous motion and ease of action. It is near-perfect in efficiency. It typifies the spirit of Spicer engineering in power transmission units.
Designing Developing Engineering
Spicer
Manufacturing and Service

engineered for excellence

The Spicer *Fully-Synchronized* Transmission is man's outstanding example of efficiency in transferring automotive power. It is silk-smooth in action. Remarkably simple and sure in control. It's the driver's dream in heavy-duty truck and bus operation . . . the equipment owner's ideal in economical service. Since 1908 the Spicer Fully-Synchronized Transmission has been the

Standard of the Industry

SPICER MANUFACTURING DIVISION *of Dana Corporation*
TOLEDO 1, OHIO

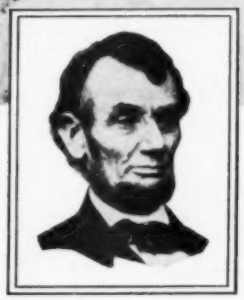


49 YEARS OF **Spicer** SERVICE

ENGINEERING **DANA** MANUFACTURING

TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES

We endorse the Junior Achievement Program



Hunting—another great American heritage

Every American has read Abraham Lincoln's "Gettysburg Address"—but few even know of his dramatic poem "The Bear Hunt," in which he clearly depicts the chase and kill—

"But woe for the bruin's short-lived fun,
When rose the squealing cry,
Now man and horse, with dog and gun,
For vengeance at him fly."

This homespun classic reveals Lincoln's thoughts and feelings about the red-blooded action of hunting . . . displays the varied highlights of hunting that have attracted sports enthusiasts through the years.

Many famous figures in American history have enjoyed hunting more than any other form of sport. It has long built character, self-reliance and endurance . . . given millions of marksmen hours of keen enjoyment and satisfaction.

You can help promote the popular sport of hunting by actively supporting local and national conservation programs. Conservation today means good shooting tomorrow!

N.R.A. RANGER

WRITE FOR FREE BOOKLET on how to start a rifle club . . . win Ranger Shooting Emblems. Sportsmen's Service Bureau, Department D-2, Sporting Arms and Ammunition Institute, 343 Lexington Avenue, New York 16, New York.

DU PONT
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DU PONT SPORTING POWDERS

WORLD-FAMOUS SINCE 1802

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

NOW...

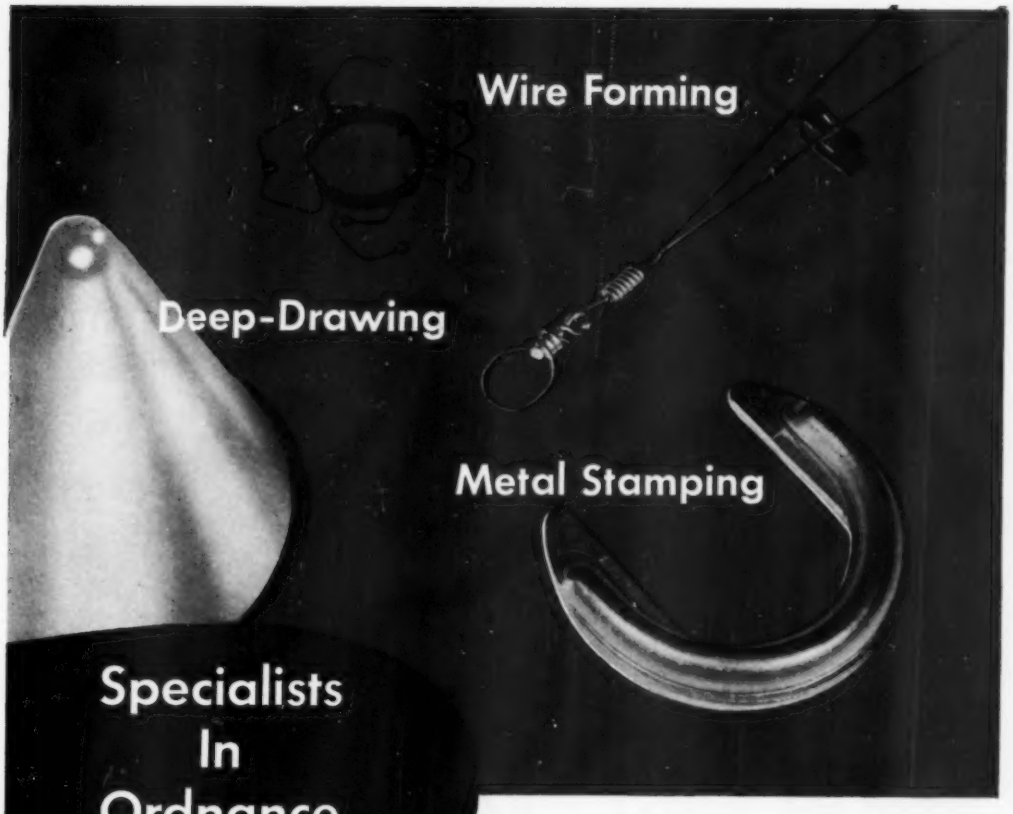
full qualification approval,

MIL-M-10304 U.S. Signal Corps

--Ruggedized Meters

Weston Ruggedized Instruments (Model 1521 Class 52—300 microamperes through 8 milliamperes d-c inclusive) have received full qualification approval from the U. S. Signal Corps under specification MIL-M-10304. For full information contact your local Weston representative or write: Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON *RUGGEDIZED INSTRUMENTS*

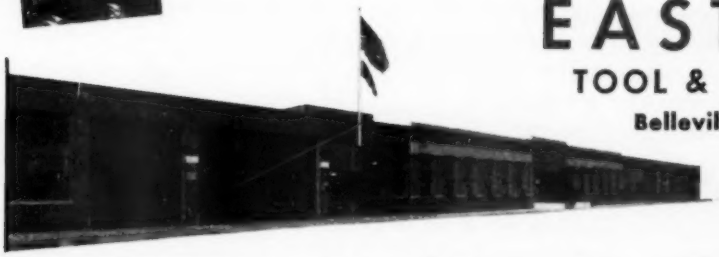


Specialists In Ordnance Components

Eastern Tool & Mfg. Co. are specialists in the design and manufacture of precision made ordnance components such as those illustrated. We are experienced in the quantity fabrication of intricate and difficult shapes, involving the use of special metals and varied types of assembly operations.

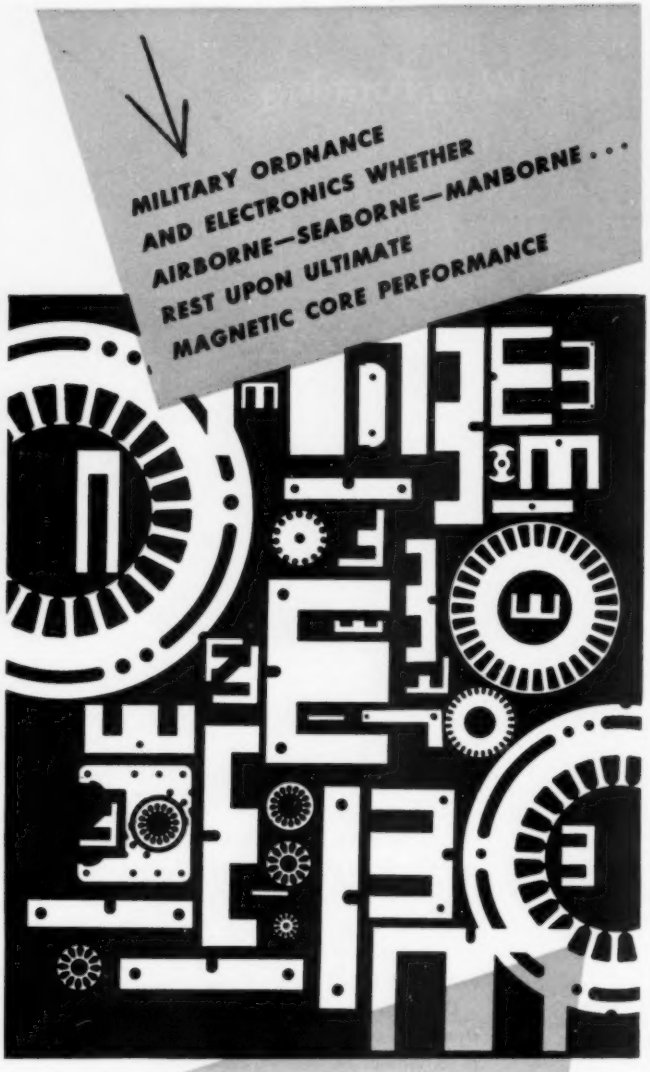
Ordnance contractors requiring wire forms, metal stampings or precision deep-drawn parts are invited to consult our engineering department.

Send for your copy of the new Eastern Tool & Mfg. Co. descriptive booklet No. 100 for the story of our services.



EASTERN
TOOL & MFG. CO.
Belleville 9, N. J.

Wire Forming · Metal Stamping · Deep-Drawing



▶ Wherever critical performance standards are closely related to mandatory production schedules, Magnetic Metals Company provides stamped lamination cores mass produced to highest quality specifications.

MAGNETIC METALS COMPANY

Soft Iron and Alloy Cores and Shields

21ST & HAYES AVENUE • CAMDEN 1, N.J.

Give your appliances this EXTRA VALUE ...at NO extra cost!

MARK-TIME *two-speed* **BELL TIMER**

Normally supplied with Center Stud mounting.

The exclusive, patented 2-speed feature of this Mark-Time unit makes it TWO timers in one! . . . and puts more "sell" into your appliances!

Here's why: in the long-time position, the user can measure time up to ONE HOUR for baking, roasting, stewing and other lengthy cooking operations . . . can use it as a reminder for appointments and other household jobs, too! By moving the lever to the short-time position, the user can obtain settings within seconds for boiling eggs, pressure cooking . . . precise timing for all short time jobs up to SIX MINUTES, where even fractions of a minute are important.

At the end of the pre-set time period, in either long or short range, this timer gives a clear, resonant bell signal.

Available with a wide variety of modern dials and knobs; also in 2-hour, 12-minute range.

Write today for full details and prices.

MARK-TIME

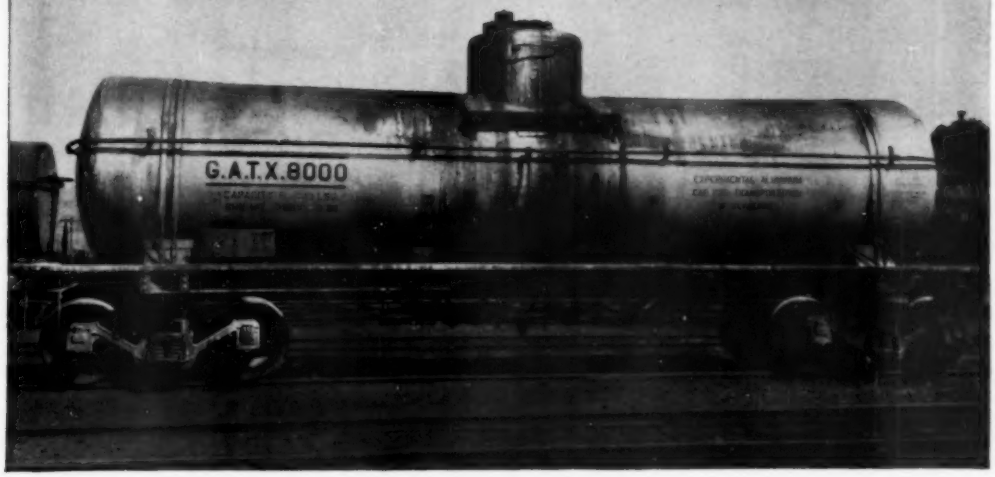
M. H. RHODES, INC.

HARTFORD, CONNECTICUT

Manufactured and sold in Canada by SPERRY GYROSCOPE OTTAWA, Limited 3 Hamilton St., Ottawa, Ontario, Canada

THEY MADE HISTORY!

This car, and the men who designed it



Back in 1928 Alcoa engineers pointed out the advantages that aluminum would bring to railroad tank cars carrying hard to hold chemicals; easily contaminated foods. So Alcoa designed and undertook to pay for the first aluminum tank car. The car builder and a shipper became interested. On completion of the car, the builder assumed the cost and leased it to the shipper for regular service.

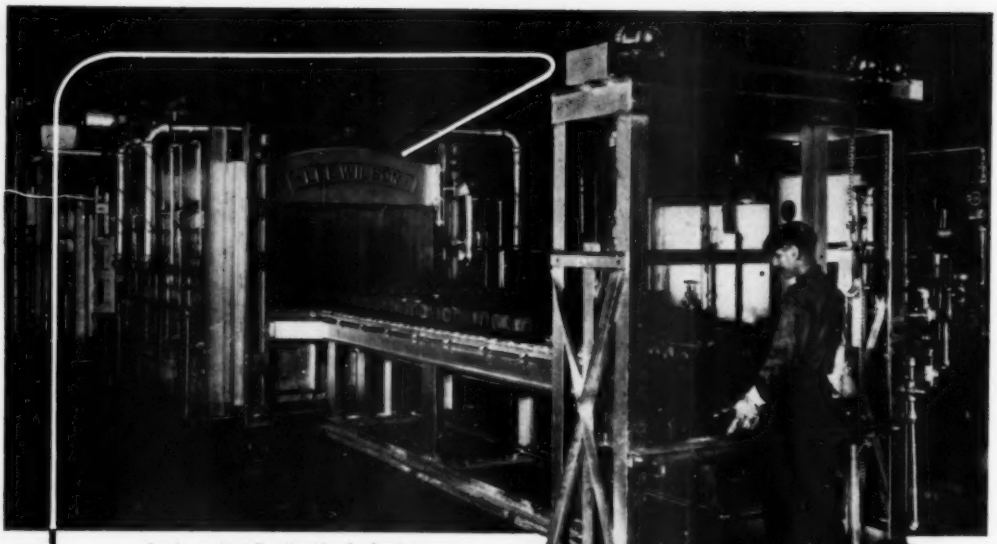
Interest in aluminum tank cars increased. Impact recorders and strain gauges gave the designers new data. The aluminum production men rolled the heaviest plate; made the largest rivets produced up to that time. The second car was made from 8 instead of 16 plates. Joining time cut in half!

Today three plates, plus heads, joined by newly developed welding methods make an aluminum tank car. And 1,300 of them, including the first one ever made, are in service.

Another instance where Alcoa engineering and co-operation have brought the advantages of aluminum to a new application. The same research, test and development facilities stand ready to help you make the best possible use of aluminum for defense needs. Aluminum Company of America, 850-C Alcoa Building, Pittsburgh 19, Pa.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA



Continuous Heat Treating Line for forgings and steel castings, consisting of a Hardening and Draw Furnace, with Automatic Oil Quench, Wash and Tray Return.

THE IMPORTANT STORY IS **BEHIND** THIS PICTURE...

"HUNDREDS OF ENGINEERING YEARS" OF FURNACE KNOW-HOW

MODERN INDUSTRIAL FURNACES FOR GAS, OIL, ELECTRIC HEAT TREATMENT OF...

Armor Plate
Armor Piercing Shot Bar
Gun Barrels, Mounts, Breech Blocks
Recoilless Rifle and Mortar Tubing
Aircraft Jet Parts
Bullet Core Rod
Artillery Shells
Tank Turrets—Hulls—Race Rings
Propellers—Aluminum Alloy or Alloy Steel
Landing Gears—Airframes
Steel Casting Annealing

ALUMINUM HEAT TREATING INCLUDING

Homogenizing furnaces
Preheating furnaces—Reheat furnaces
Solution furnaces
Ageing and Annealing furnaces—ovens
Heat Treating furnaces for Dies, Mandrels, Backers
Form Die Quenching

In the "Minds of Men" are created the engineering designs for the custom building and erection of modern heat treating furnaces and auxiliary equipment. This is the important story behind any furnace installation. The Lee Wilson Contracting Company using the Designs and Patents of Lee Wilson Engineering Co., Inc. has combined experience in design and erection totaling "hundreds of engineering years" at your disposal. We cordially invite your request for bids or expression of interest.

LEE WILSON
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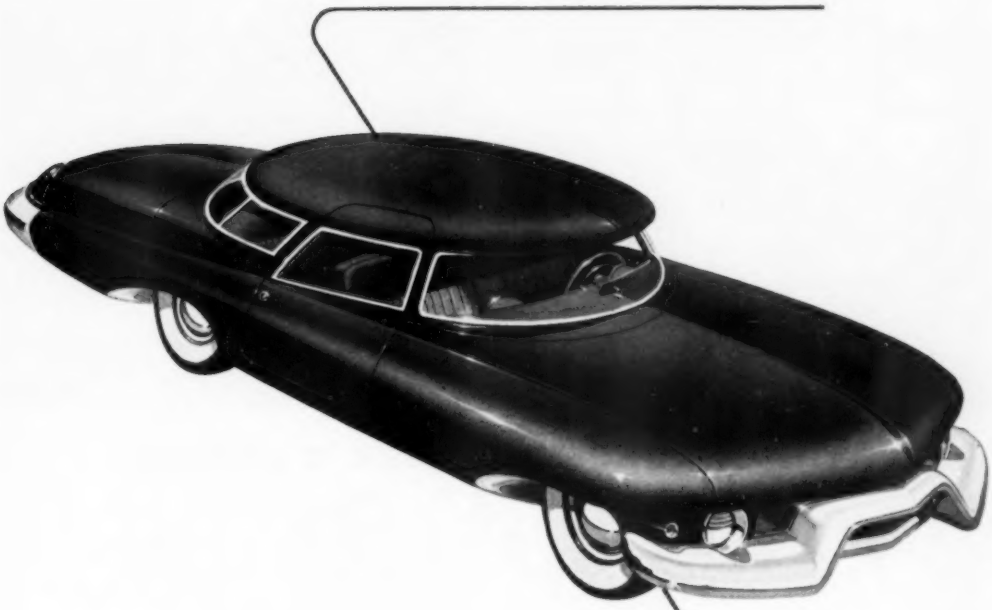
20005 WEST LAKE RD. • CLEVELAND 16, OHIO

Specify N-A-X HIGH-TENSILE STEEL for Lighter Weight Longer Life with Economy



N-A-X HIGH-TENSILE, with its 50 percent greater strength than that of mild carbon steel, means that thinner sections can be used . . . resulting in lighter weight of products. Because it is an alloy steel, it possesses much greater resistance to corrosion with either painted or unpainted surfaces. It has high fatigue and impact values, at normal and sub-temperatures, with the abrasion resistance of a medium high carbon steel . . . resulting in longer life of products.

N-A-X HIGH-TENSILE has outstanding cold-forming properties, and its response to welding, by any method, is excellent. Due to its inherently fine grain and higher hardness, it can be ground and polished to a high degree of lustre at lower cost than possible with mild carbon steel.

Your product can be made lighter in weight . . . to last longer . . . and in some cases, be manufactured more economically, when made of N-A-X HIGH-TENSILE steel.

MAKE A TON OF SHEET STEEL GO FARTHER. Specify N-A-X ... And "MAKE YOUR PRODUCT LAST LONGER"

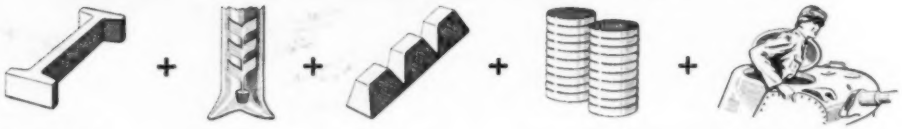
GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division • Ecorse, Detroit 29, Michigan

NATIONAL STEEL CORPORATION

KEEP YOUR SCRAP MOVING TO YOUR DEALER

What it takes to silence a pillbox!



Steel: 90,000 lbs. Rubber: 1,800 lbs. Copper: 2,000 lbs. Bronze: 100 lbs. Specialized Personnel: 5

A single blast from a 105 mm. howitzer can reduce a pillbox to smoldering silence! This tremendous firepower is awesome... only a mount of great strength can withstand its recoil.

American Machine and Foundry Company's vast manufacturing facilities guide the production of these mounts from initial stage to the time they're ready for action.

AMF is pleased to make its contribution to Army Ordnance. Along with thousands of other companies we are utilizing industrial *skill* and *speed* to insure America's military readiness.

Above figures are given with due regard to security.

AMERICAN MACHINE & FOUNDRY COMPANY

Executive Offices, 511 Fifth Avenue, New York 17, N. Y.

AMF does it better—automatically!

CREATORS AND PRODUCERS OF ELECTRONIC AND MECHANICAL EQUIPMENT FOR THE ARMED SERVICES: Radar antennae and drive units • automatic loaders for Army and Navy weapons • elevating and azimuth mechanisms • cooling fans for Army tanks • airplane parts • mobile ovens • electronic training devices • naval ordnance • rolled and welded steel products • shell components • silver-zinc batteries • special military projects.

Why.....

magneto ignition?

BENDIX Magneto Ignition has traditionally been used on engines in critical installations where "keeping the engine going" is a "must."

BENDIX Magneto Ignition, an independent self-sufficient system, places no demands on a normally loaded electrical supply.

BENDIX Magneto Ignition produces a hot spark at all speeds.

BENDIX Magneto Ignition provides for ease of service due to its compactness and simplicity.

BENDIX Magneto Ignition minimizes fire hazard with elimination of supply leads.

BENDIX Magneto Ignition inherently provides superior radio-shielding and water-proofing.

BENDIX Magneto Ignition contact points and distributor electrodes have longer life because of inherent current reversal.

BENDIX Magneto Ignition has proven its efficiency, reliability and safety by its use on piston engine aircraft where no compromise is accepted.

Ordnance standards for material and equipment are necessarily the highest. Vehicles of all types must operate at maximum efficiency under every conceivable condition. Servicing must be accomplished simply and speedily, and long, dependable life for every component is a prime requisite. It is evident that magneto ignition provides the superior qualities that are required for ordnance vehicles.

Bendix

SCINTILLA MAGNETO DIVISION OF
SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, New York

FACTORY BRANCH OFFICES: 117 E. Providencia Avenue, Burbank, California • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan

Brouwer Building, 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

A VITAL FORCE IN NATIONAL DEFENSE

Chrysler Airtemp

"Packaged" Air Conditioner

Easily installed. Cools, dehumidifies, filters, circulates, ventilates. Six models 2 to 15-H.P. capacities—to meet most cooling needs.

Machine Tool Coolant Cooler

Keeps coolants in automatic machine tools at a constant temperature. Helps provide greater precision, higher production. Reduces friction heat.

Chrysler Airtemp has won recognition as an outstanding factor in the national defense effort. By waging war against enemies of production, precision and perishables: uncontrolled dust, humidity and temperatures—Chrysler Airtemp is making a major contribution to the armament program. On all fronts—at home and abroad—in assignments that cover every application of temperature and humidity control, Chrysler Airtemp is serving with distinction. A complete range of products enables Chrysler Airtemp to provide the answer to production problems involving control of indoor atmospheric conditions.

Room Air Conditioner

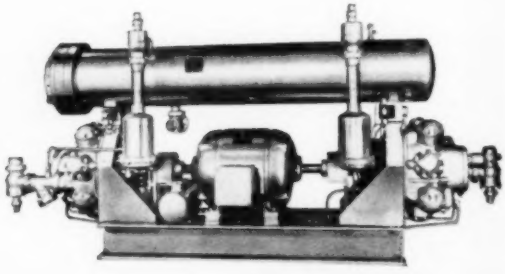
Fits in window, cools, filters and circulates fresh outside air. Ideal for offices, hospital convalescent rooms, workshops or other small areas.

Chrysler Airtemp

HEATING • AIR CONDITIONING

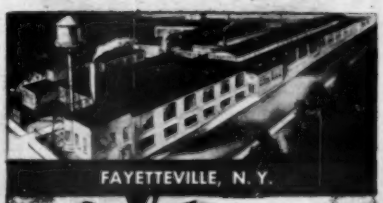
for **HOMES, BUSINESS, INDUSTRY**

Airtemp Division, Chrysler Corporation, Dayton 1, Ohio



Central Station Unit

For large installations. This unit forms the heart of many air conditioning, cold storage and other temperature and humidity control systems.


FAYETTEVILLE, N. Y.

FAYETTEVILLE, N. Y.
MAGNESIUM PLANT

FAYETTEVILLE, N. Y.

SYRACUSE, N. Y.

SYRACUSE, N. Y.

CORTLAND, N. Y.

You Can Depend On QUALITY DIE CASTINGS From PRECISION'S

9 Completely Equipped Plants!

Out of these nine Precision plants comes a constant stream of top quality die castings to keep the production lines of industry moving to new high production peaks. Large and small users of die castings are assured of on-time deliveries of the best die castings they can buy.

Precision know-how in producing better die castings plus superior plant facilities can help you meet your production and sales quotas.

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BRADLEY-EDLUND DIVISION
Edlund Drilling and Tapping Machines
Bradley Forging Hammers

PRECISION CASTINGS CO., Inc.
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British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

Ask the Man Who Has to Get the Work Out!

"Buffalo" No. 15
Single Spindle
Bench Type Drill.
1/2" capacity in cast iron.

"Buffalo" No. 15 Floor Model Drill

"Buffalo" DRILLS Reduce Fatigue, Setup Time, Waste Motion and Rejects

Ask the drillpress operator what's desirable in a drill—he'll mention controls you can reach without stretching or being cramped—setup adjustments you can make without being a Master Mechanic—and a drill you can run the entire shift without babying. That's why so many in the operating group prefer "Buffalo" No. 15 Drills. The 3-spoke feed handle—The handy crank adjustments—the easy speed changes—and the precision fitted alloy steel spindle turning smooth and true on ball bearings—all contribute to more drilling and better drilling per man. WHY NOT WRITE FOR YOUR COPY OF BULLETIN 2963-G and see the wide variety of models (in 1 to 6 spindles) ready to solve your drilling, tapping, reaming, routing and other problems!

DIAMOND JUBILEE 75 YEARS ANNIVERSARY

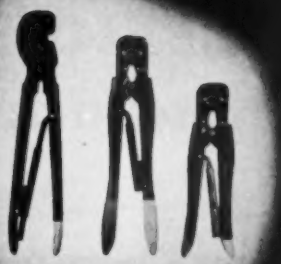
"Buffalo" MACHINE TOOLS

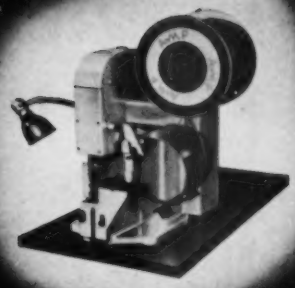
BUFFALO FORGE COMPANY

173 MORTIMER STREET BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING CUTTING BENDING





it's the Extra Factor of Assurance that counts...

All the gadgets or combination tools in the world will not insure the correct installation of your wire terminations day in, day out, on the line. It's the extra factor of assurance that counts! AMP tools and terminals are made to use together. They're made so that you can be *sure* that you have a correctly installed termination. AMP application tools and dies and automatic machines are so designed that at the point of application you can control accuracy and uniformity within ±.003". Remember: In wire termination there is no short cut to precision and foolproof production!

Shown below: AMP CERTI-CRIMP* hand tools—will not release until proper crimping pressure has been reached. (Below right) the AMP INSPECTO-MASTER* gives continuous inspection at point of terminal application. Write to AMP for information about these and other recent developments in wire termination.

A-MP CONTROLLED WIRE TERMINATION

YOU CAN COUNT ON AMP

AMP

AIRCRAFT-MARINE PRODUCTS, INC.

2100 Paxton Street, Harrisburg, Pa.

Canadian representative:
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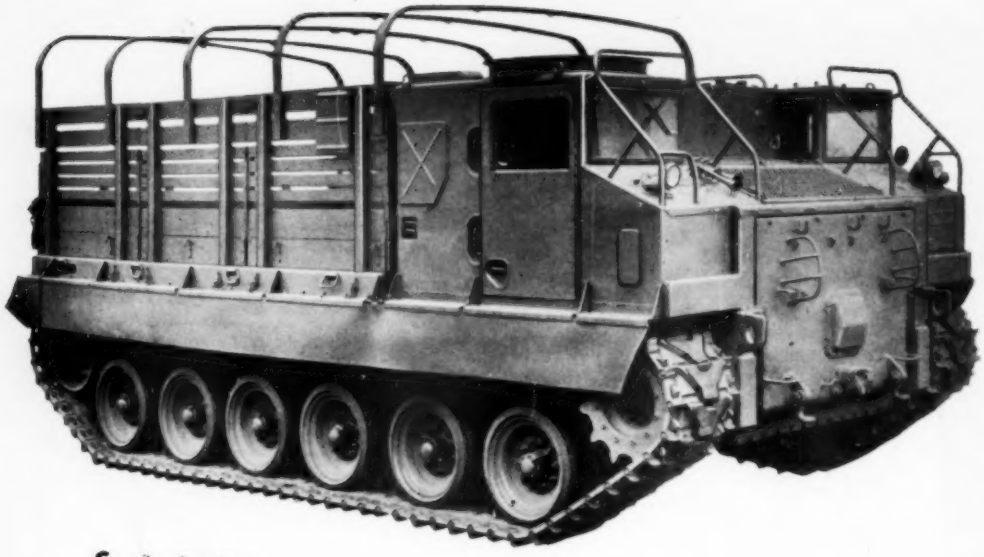
AMP Trade-Mark Reg. U.S. Pat. Off.

*Trade-Mark

SERVICING EFFICIENCY
starts on the drawing board



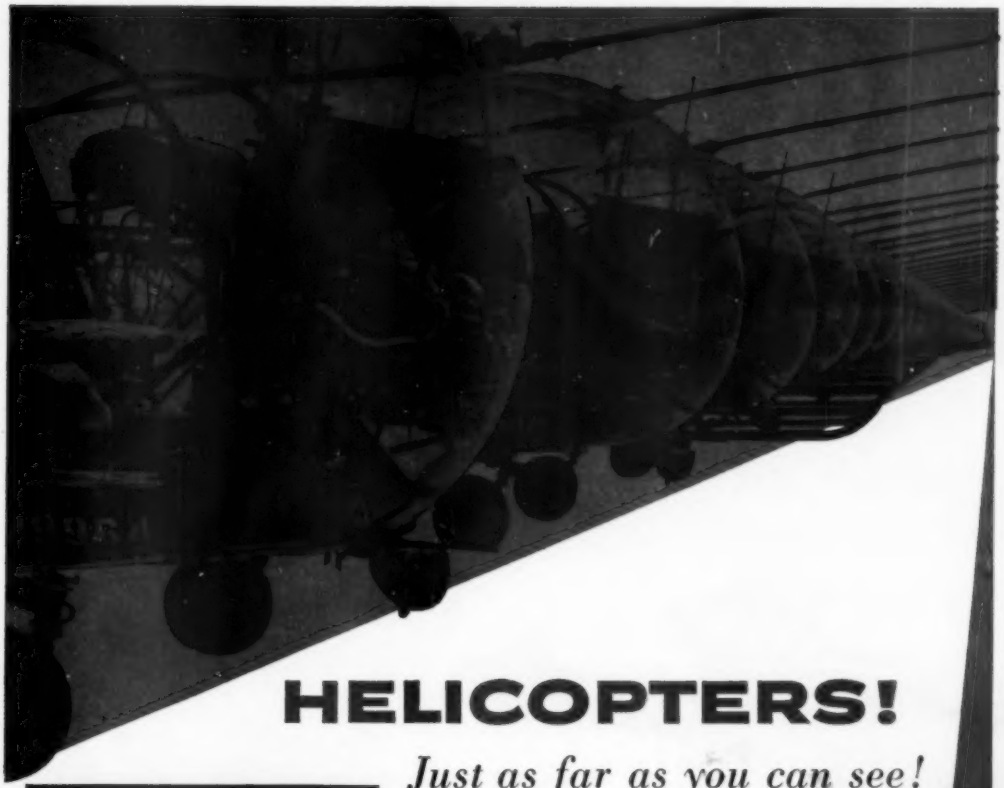
Careful planning in the original design of a military vehicle results in great savings of parts and servicing time. Just as important, it simplifies and speeds the training of servicemen.

That's why the M8E2 cargo carrier was designed so that the following major components, plus countless small parts, are interchangeable with those of other members of the light tank family:

1—ENGINE, 2—CROSS DRIVE (including torque converter and entire gear train) 3 — SUSPENSION (including torsion bars, road wheels, trailing idler, final drive and support rollers) and 4—TRACK.

This built-in efficiency was achieved by Allis-Chalmers through the cooperation and coordination of the Ordnance Corps. Experience has shown that the extra time and pains taken in the original planning are repaid many times over in the field where time, men and materiel are at a premium.

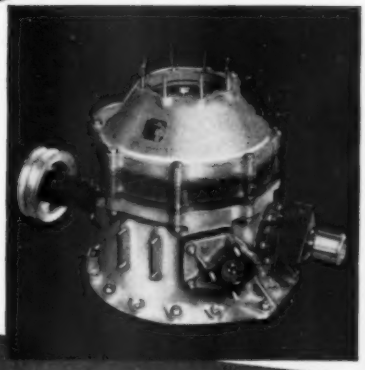
ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.



HELICOPTERS!

Just as far as you can see!

And with our precision gears they do the most amazing things!



A lot of the performance in terms of smooth even power is due to the precision-made Rotor Transmission Manufactured by the Steel Products Engineering Company for the Bell Aircraft Corporation.

For 38 years we have been designing and producing gears, gear assemblies, and other components which have the highest possible precision characteristics.

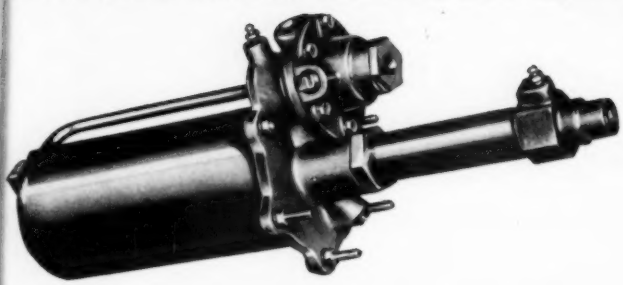
THE STEEL PRODUCTS ENGINEERING CO.

engineers and manufacturers • Springfield, Ohio

Bendix

AIR-PAK

combines the advantages of air power with hydraulic brake actuation



Here, with a single compact, easy-to-install power braking unit, truck manufacturers and operators can combine all of the well proven advantages of hydraulic brake actuation with an air brake system.

Bendix® Air-Pak changes air pressure into hydraulic pressure by means of two directly connected pistons. Thus, a non-compressible column of brake fluid instead of air connects between the driver's foot and the brake shoe. The result is faster brake action, more positive and better control.

Another important Air-Pak advantage is the fact that brakes can be applied instantly by foot power alone—an emergency standby when braking is required before air pressure builds up, or if air pressure fails for any reason.

Important, too, is the fact that Air-Pak is a product of Bendix, designer and builder of Hydrovac®, the world's most widely used power brake with over three million units now in use.

Thus Air-Pak benefits from a specialized engineering and manufacturing experience unrivalled in the automotive industry.

Descriptive folder on Air-Pak is available on request.

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Bendix Products Division

THE MOST TRUSTED NAME IN BRAKING

BENDIX · PRODUCTS DIVISION · SOUTH BEND, INDIANA

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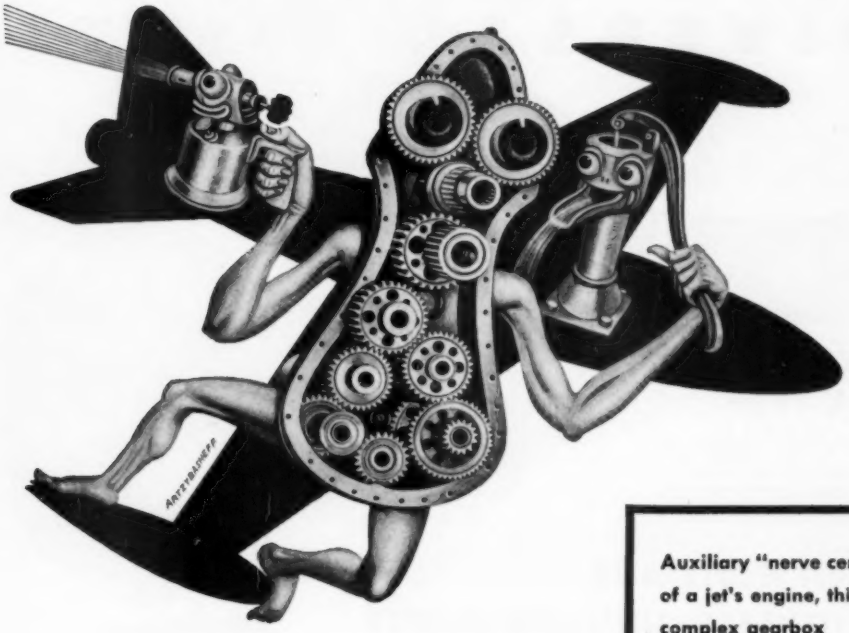
Bendix AVIATION CORPORATION

How a jet engine runs on its "nerves"



Auxiliary "nerve center" of a jet's engine, this complex gearbox transmits the power that runs oil and fuel pumps, generators, and other vital accessories. To produce this intricate unit for J-40 engines, Westinghouse looks to Lycoming for precision production.

From a jet's mighty engine, these precision gears "take off" power and pass it along to vital accessory equipment *at the specific rate required by each different* unit. As many as 30 separate gears . . . as many as 2500 separate machining and assembly operations . . . go into this gearbox so essential to safe, efficient operation of a jet. And for this tremendously complex production, Westinghouse depends on Lycoming.

Lycoming stands ready to assist *you*, too. Whether you have "just an idea" that needs development, a problem in the blueprint stage, or a finished metal product that needs precise, speedy fabrication . . . you can depend on Lycoming's long-tested ability to meet the most exacting and diverse industrial or military requirements. *Whatever* your problem—look to Lycoming!

Lycoming's 2½ million feet of floor space, its more than 6,000 machine tools, and its wealth of creative engineering ability stand ready to serve your needs.

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION

LOOK TO LYCOMING FOR RESEARCH FOR PRECISION PRODUCTION

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Please send me further information on Lycoming's varied abilities and facilities.

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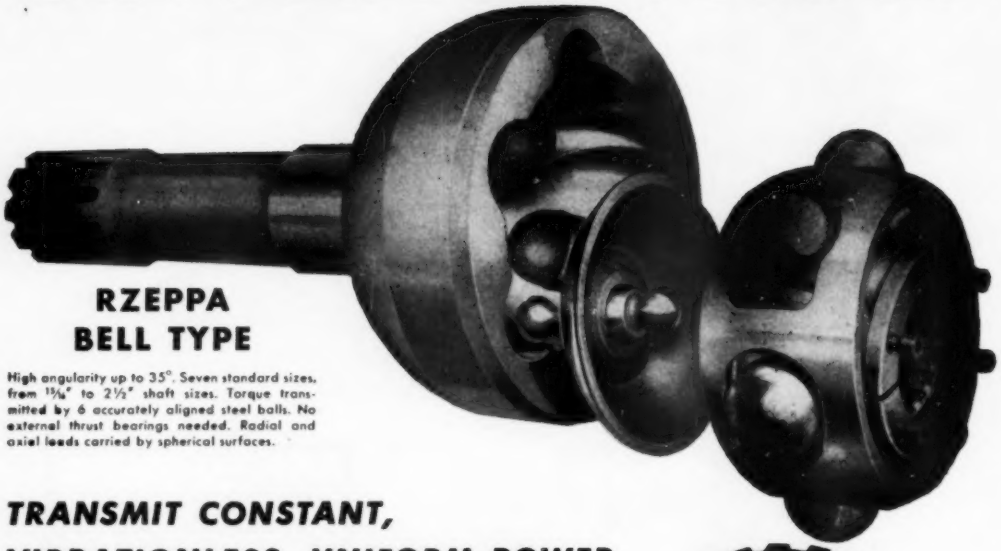
CONSTANT VELOCITY
UNIVERSAL JOINTS



RZEPPA BELL TYPE

High angularity up to 35°. Seven standard sizes, from 1⅛" to 2½" shaft sizes. Torque transmitted by 6 accurately aligned steel balls. No external thrust bearings needed. Radial and axial loads carried by spherical surfaces.

TRANSMIT CONSTANT, VIBRATIONLESS, UNIFORM POWER

These joints offer ordnance and industrial design engineers true constant velocity—free from the alternate pulsations that set up vibration even at slight angularity and destructive force as angularity increases.

The field records of over two million Rzeppa joints in the several divisions of our armed forces prove their dependability. The Rzeppa joint consists of an outer driving member and an inner driving member, with a ball cage between them—all assembled into a concentric unit. Each of the six balls transmits torque by free rolling action. No tools are required to assemble the various parts which position each other securely by interlocking. The result is a joint combining great strength, high capacity, constant velocity, compactness, low friction losses and the utmost in dependability.

You are invited to discuss any problems concerning universal joints with our engineering staff, whose long experience in many fields is available to manufacturers of ordnance and industrial products.

RZEPPA DISC TYPE

For low angle operation. Capable of 18° deflection. Sizes from 3-9/16" O.D. taking 15/16" shaft, to 10½" O.D. taking 3" shaft.

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The **GEAR GRINDING MACHINE CO.**

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RZEPPA Constant Velocity Universal Joints

Logging in Oregon's Cascade Mountains

means
EXTRA
PERFORMANCE
for Ordnance
vehicles

Mighty Bendix-Westinghouse Air Brakes Provide Perfect Control on Toughest Logging Hauls!

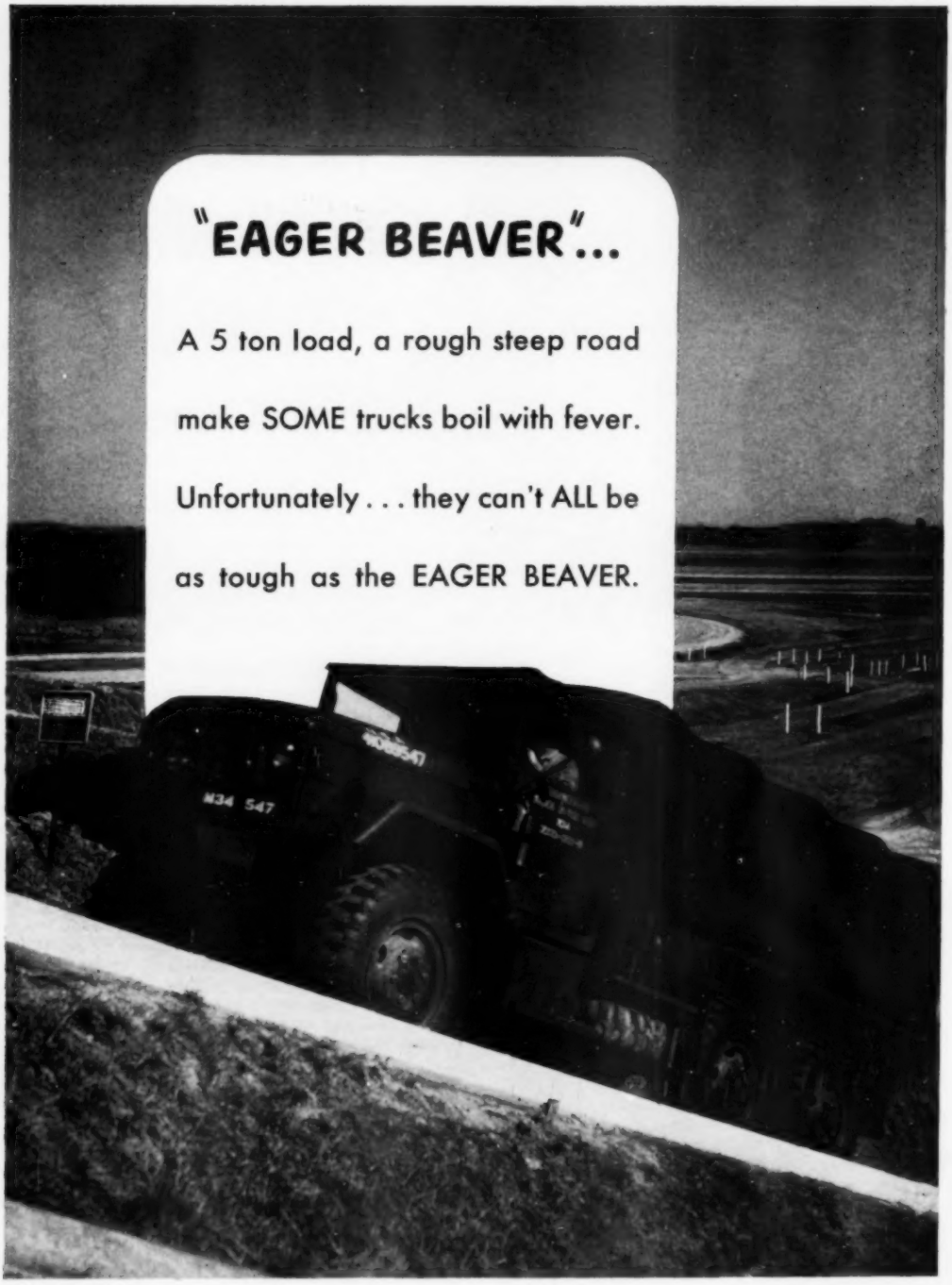
Take a 275-horsepower, 15-ton logging tractor and trailer rig . . . pile on more than 70 tons of giant timbers . . . add mile after mile of treacherous 20% mountain grades and you've got a good picture of a job where only the **very best brakes** are good enough. And in the logging industry that means only one thing—Bendix-Westinghouse Air Brakes! That's because these mighty brakes, built by the industry's most experienced manufacturer, pay off with the **extra stopping power and performance** that assure the safest, surest, most dependable braking action and longest service life in the business. And these are factors that make these mighty brakes **your logical choice** for any Ordnance vehicle. That's why, when you specify brakes, you can be sure of the **utmost in safety, dependability and stamina** by specifying Bendix-Westinghouse—the world's most tried and trusted air brakes! Performance proven **for peak reliability** on Ordnance vehicles in World War II.

Bendix-Westinghouse

THE WORLD'S MOST TRIED AND TRUSTED

AIR BRAKES

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY • ELYRIA, OHIO • BERKELEY, CALIF.


"EAGER BEAVER"...
A 5 ton load, a rough steep road
make SOME trucks boil with fever.
Unfortunately . . . they can't ALL be
as tough as the EAGER BEAVER.
M34 547

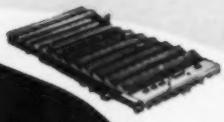
REO MOTORS, INC., LANSING 20, MICHIGAN

Kelsey-Hayes

Know How

...in DEFENSE and PEACE-TIME production

Kelsey Hayes



Kelsey-Hayes
Los Angeles, Cal. Plant

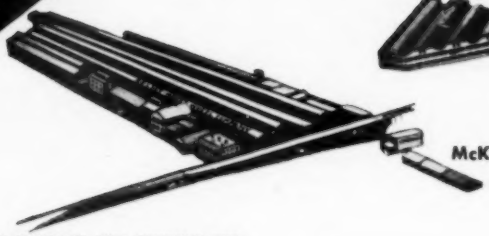
Kelsey-Hayes
Detroit, Mich., McGraw Plant

Kelsey-Hayes
Windsor, Ont., Canada Plant

Kelsey-Hayes
Detroit Mich., Military Plant

Kelsey-Hayes
Jackson, Mich. Plant

Kelsey-Hayes
Davenport, Iowa Plant



Kelsey-Hayes
McKeesport, Penna. Plant

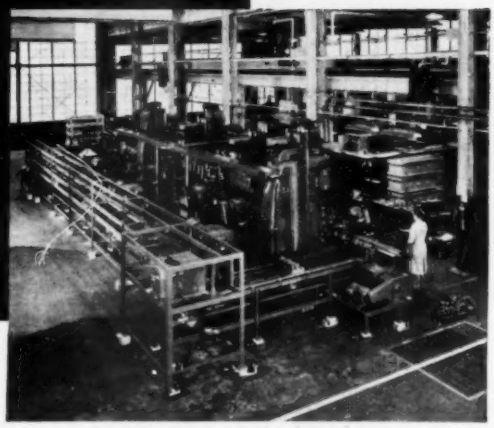
FOR MILITARY AND CIVILIAN USE:

- Wheels, brakes, hubs and drums for cars, trucks, tractors . . . and cargo trailers, troop carriers, gun carriages, tanks, etc.
- Electric brakes, brake power equipment, power chambers . . . and valves for all types of military and civilian vehicles.
- Shells and shell casings, rockets, and aircraft engine parts, etc.

KELSEY-HAYES WHEEL COMPANY
MILITARY AVE., DETROIT 32, MICHIGAN

Ordnance Equipment by W. F. & JOHN BARNES

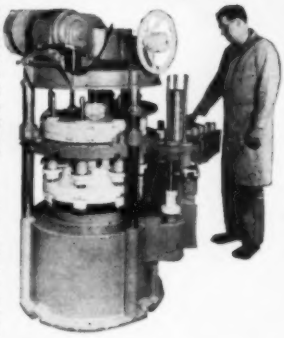
Here are only a few of the pieces of equipment built by W. F. and John Barnes for ordnance. In addition to many other individual pieces we have designed and built an entire plant for the automatic production of 155 mm high explosive shells. Other projects of a similar magnitude are now in progress. We will be glad to work with you on any machining or processing problems pertaining to ordnance.



Fast, Efficient Double Seamer

Here's a new closing machine (double seamer) that features simplicity of adjustment, fast operation and identical seams. Its speed of operation is limited only by slower operating equipment in the line. It has a minimum of parts, resulting in low maintenance costs and requires comparatively little floor space.

FEATURES of this new machine include a single adjustment for obtaining uniform seams consistently, moderate spindle speeds which eliminate "bounce" over side seams, and insure positive sealing. In addition, the design of the end feed makes it possible to take a wider variation in end sizes.



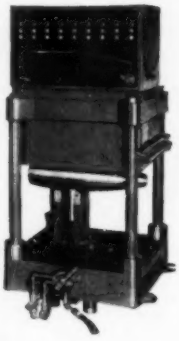
High Production Transfer-Type Machines

Above, many progress-thru type machine tools employ fixtures which must be returned to the loading end of the machine, and this special Barnes conveyor is built to accomplish this purpose automatically and in time with the cycle of the machine. The machine itself, and all its hydraulic equipment and control circuits are also Barnes products. This 24 station machine performs 116 operations automatically on compressor frames.

Special Conveyors

Left, a type of conveyor designed and built by Barnes for removing chips from machine tools, particularly those of the progress-thru type. Chips and cuttings are directed into the long trough and conveyor located in or under the machine. This heavy drag type conveyor delivers the chips to an elevator of similar chain design, from which they can fall into a waiting tote box. Variations of these units are adaptable to a wide range of applications.

Electrical Controls and Checking Equipment



Complete electrical circuits and controls have been designed by W. F. and John Barnes for a wide variety of installations. Shown to the right is an electronic gauge which simultaneously checks 9 significant dimensions on a 155 mm shell. Signal lights instantly indicate "over", "under", or "within limit" for each gauging point.

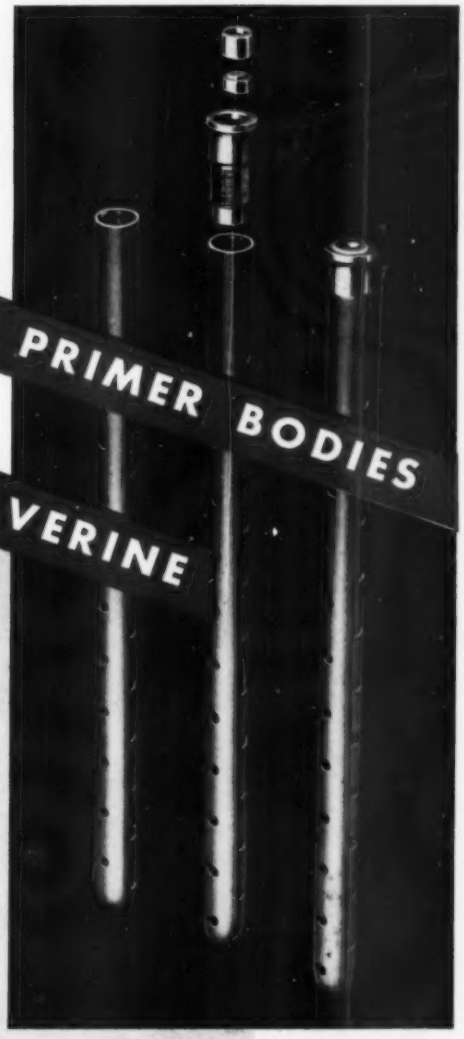
Free Additional Data

is available on all Barnes Ordnance equipment. Since it is impossible to give the complete scope of operation in this restricted space, we invite you to write for the complete Barnes Ordnance book. Ask for bulletins O-353

W. F. and JOHN BARNES

PROCESS EQUIPMENT DIVISION 328 SOUTH WATER STREET, ROCKFORD, ILLINOIS

These STEEL PERCUSSION PRIMER BODIES ARE MADE BY WOLVERINE



Made in steel and brass according to the government's exacting specifications for the defense program, these percussion primer bodies measure .527" O.D. with wall thickness of .036". They have small holes along their full length and one end is completely closed. They are later assembled with components by customer. Primer bodies are among the many items that are fabricated by the special Spun End Process† developed by Wolverine. This fabrication should suggest the use of the Spun End Process in the production of other items you may now be producing with more complex operations. This forming operation is speedy, simple and economical.

Our extensive experience in tube fabrication can provide much help to you—in making products both for the defense program and for civilian use as well.

†A Patented Process RE 22465

We invite discussions with our Customer Engineering Service.

Other Wolverine Products

CAPILATOR*
—the capillary tube for restriction purposes
COMMERCIAL TUBE
AUTOMOTIVE TUBE
CONDENSER TUBE
COPPER WATER TUBE (K-L-M)
ELECTRIC WELDED STEEL TUBE
FABRICATED TUBULAR PARTS
WOLVERINE TRUFIN*
—the integral finned tube
REFRIGERATION AND AIR CONDITIONING TUBE (Plain or Tin Plated)
S.P.S. PIPE
SPUN-END TUBE†

*Reg. U.S. Pat. Off.
†A Patented Process RE 22465

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Many of our branches are equipped to slit, saw, or shear our metals or your own stocks to specifications.

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Baltimore	Dallas	Kansas City, Mo.	New Orleans	Rochester†	
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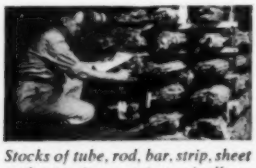
Deliveries to your factory by truck, rail or express, if desired.

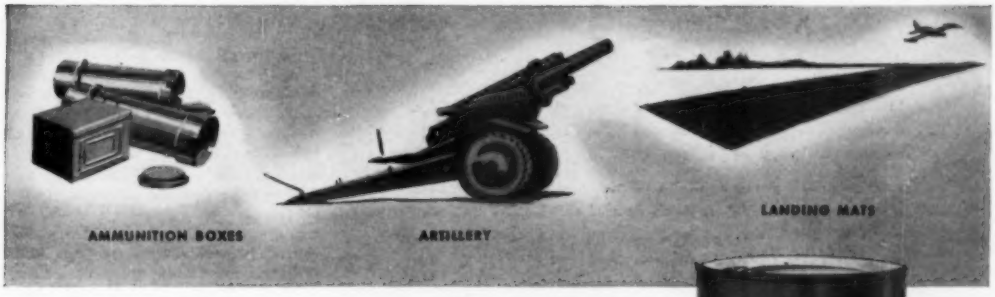
Close tolerance sawing, slitting, shearing to your specifications.



Stocks of tube, rod, bar, strip, sheet and wire in a variety of alloys.

Fitted to every military need—

Glidden Specification Finishes



When it comes to supplying specification finishes, The Glidden Company has the background of experience . . . the extensive laboratory and production facilities . . . and the field service follow-through to meet every requirement. Specify Glidden quick-drying enamels, primers, lacquers, or temporary strip coatings. You are assured of the highest quality in finishes "custom-tailored" to your facilities. Write today for detailed specifications.

THE GLIDDEN COMPANY
NATIONAL DEFENSE DEPARTMENT
11005 Madison Avenue ★ Cleveland 2, Ohio

SALES OFFICES AND FACTORIES: San Francisco, Chicago (Nubian Division—1855 North Leclaire Avenue), Minneapolis, New Orleans, St. Louis, Cleveland and Reading

ATOMIC ENERGY

ATOMIC ENERGY IN 1952

Most spectacular scientific event of 1952 was the Eniwetok test by the Atomic Energy Commission, which was officially described as a "thermonuclear reaction" and was possibly the explosion of the world's first hydrogen bomb. Dr. C. G. Suits, General Electric's vice-president and director of research, speaking on scientific achievements of 1952, said "the release of nuclear energy on such an enormous scale will profoundly influence the progress of mankind—for good or for evil."

Another important project in the nuclear-energy field that got under way during the past year was the construction of a nuclear power plant for submarines by the Knolls Atomic Power Laboratory, which General Electric operates for the Atomic Energy Commission. A prototype test reactor will be housed in a submarine hull section inside a 225-foot steel sphere at West Milton, N. Y. Construction of the sphere is now well under way.

For study of the structure of the atomic nucleus, which provides necessary information for applying nuclear energy, the most important tool is the "particle accelerator" or "atom smasher." The most powerful accelerator yet developed was placed in operation last May at the Brookhaven National Laboratory. This is known as the "cosmotron," because it develops energies comparable to those of the cosmic rays, and it will operate at energies of three billion volts. More than two-thirds of this energy has already been achieved.

Even more powerful accelerators will be possible with the aid of a significant new principle which the Brookhaven scientists discovered during the year. This is a method of focusing the atomic bullets as they are swung around and given speed. It is much like the focusing of light by the lens of a camera and will be particularly effective with large machines like the cosmotron. It will permit a reduction in the size of the magnets which guide the particles. The size of such magnets is the principal limitation on the energy that can be attained.

RADIOACTIVE TRACERS

Atomic energy has found a new peacetime rôle—the job of finding out how well soaps and detergents clean clothes. Radioactive tracers are now being used to measure how much dirt is removed from soiled clothes as well as that still clinging to the cleansed laundry.

This and other examples of recent research into the nature of washing prod-

Pressure Processing

. . . whoever uses it in their production is a customer or potential customer of **H-P-M**

Rapid-Fire . . . Accurate . . . Dependable SHELL FORGING calls for H-P-Ms!

Piercing, bottoming, drawing, nosing and living up to strict governmental production requirements are all in a day's work for H-P-M shell forging installations like this one at J. B. Beaird Company, Inc., Shreveport, Louisiana.

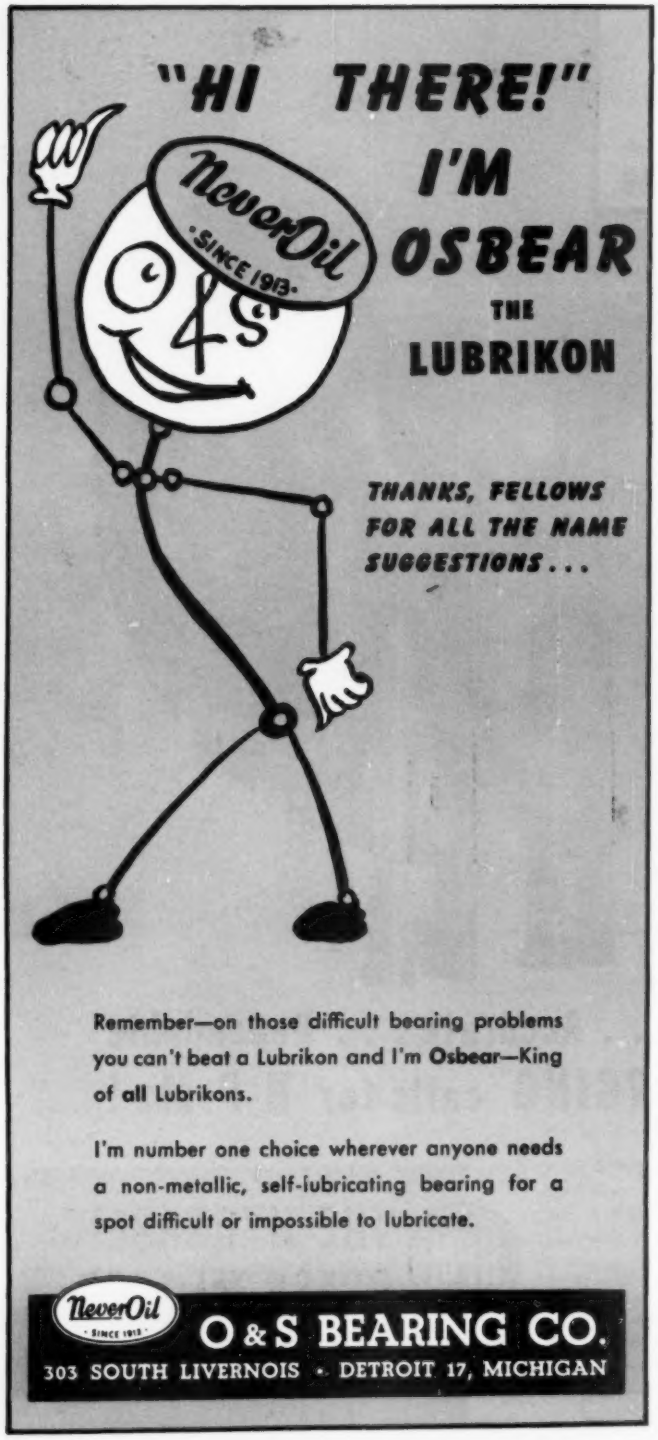
If your planning calls for forgings . . . H-P-M's proven ability to reduce scrap loss, save material and cut machining time are three good reasons why you should talk shop with an H-P-M engineer. His experience and assistance will be of real value to you at the planning stage. Write today!

HPM

THE HYDRAULIC PRESS MFG. CO.

1090 Marion Road, Mount Gilead, Ohio, U. S. A.

Presses for Every Pressure Processing Application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I'M OSBEAR
THE LUBRIKON
NeverOil
SINCE 1913
THANKS, FELLOWS FOR ALL THE NAME SUGGESTIONS . . .
Remember—on those difficult bearing problems you can't beat a Lubrikon and I'm Osbear—King of all Lubrikons.
I'm number one choice wherever anyone needs a non-metallic, self-lubricating bearing for a spot difficult or impossible to lubricate.
NeverOil
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ucts, shortenings, shampoos, and other beauty products were made public at the dedication of Procter & Gamble Company's Miami Valley Laboratories near Venice, Ohio. The new laboratory building contains the most modern research instruments, design features, and other facilities for chemical and engineering research. The staff of 300 who will work in the building includes 110 graduate chemists and engineers from 35 colleges throughout the country.

The Miami Valley Laboratories will work on long-range research problems which eventually will open up new frontiers for new and better products.

FELLOWSHIPS OFFERED

Eight fellowships in industrial medicine will be offered by the U. S. Atomic Energy Commission for the 1953-1954 academic year. The fellowship program, begun by the AEC three years ago, is designed to provide advanced training and on-the-job experience for men and women physicians in the field of industrial medicine, particularly in relation to the atomic-energy industry.

The fellowships are open to United States citizens who hold M.D. degrees from approved medical schools and who have had at least one year of internship. In exceptional cases, equivalent experience may be accepted in lieu of the internship requirement. Successful candidates must be investigated by the FBI and approved by the AEC before receiving fellowships.

Awards are for one year's academic training at institutions offering approved graduate courses in industrial medicine which can provide special training facilities in the health problems associated with the atomic-energy program. Normally, fellows will be eligible for a second, or in-plant, training year upon successful completion of the academic year. In-plant training will be given in medical departments of major AEC plants and laboratories.

There is a critical need for qualified industrial physicians in atomic-energy installations, and at the end of the 2-year training period fellows may find employment in the program. However, there will be no commitment on the part of the AEC to continue the applicant's training beyond the first year or to provide employment for him upon the completion of training. Fellows will not be obligated to take the second year of training or to seek employment with the AEC or its contractors.

MILLIONS OF KILOWATTS

The U. S. Atomic Energy Commission recently approved an agreement with a group of 15 private power companies, known as the Ohio Valley Electric Cor-

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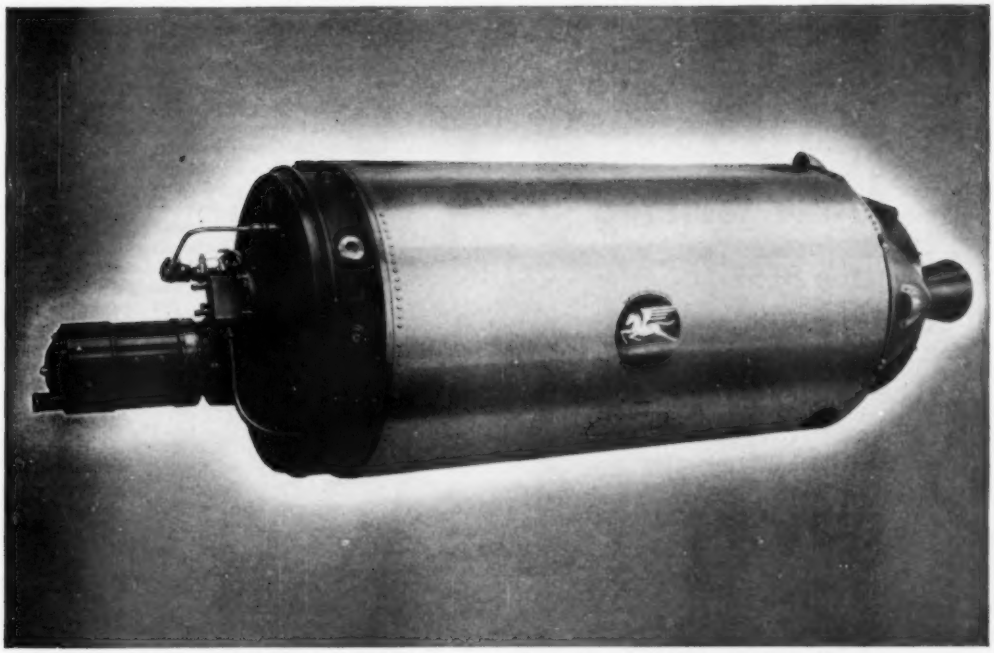

The J-44 Turbo-Jet Engine...Designed and Built by Fairchild

Here is more power to help meet America's defense needs—the J-44 turbo-jet.

Fairchild designed and built, it weighs 300 pounds and delivers 1000 pounds thrust. Compact, measuring 22 inches in diameter and 72 inches in length, it is one of the smallest engines ever made in its power class. The J-44 is another example of the Fairchild Engine Division's ability to create specialized power plants to meet exacting design requirements.

Presently Fairchild is designing and developing many other unconventional power plants—some of them for unusual applications—for our Armed Forces and is producing in quantity major components of the General Electric J-47 turbo-jet engine.

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Atomic Energy

poration, to supply 1,800,000 kilowatts of electric power required to operate the uranium-235 production plant being constructed in Pike County, Ohio.

The agreement also provides that the corporation will design and construct the necessary generating capacity, furnish reserve capacity from its systems, and make available up to 465,000 kilowatts of power from its existing systems for construction and early operation of the new gaseous-diffusion plant prior to completion of new generating facilities.

The agreement covers a 25-year period with extensions available for the Commission. The immediate liability of the AEC extends to August 1, 1953, prior to which time the AEC will request from Congress an increase in the limitation on its authority to incur liabilities for cancellation charges under power contracts.

The agreement provides for a 2-year notice of cancellation of the power demand in case the electric-energy requirements of the AEC decrease or cease before the termination of the agreement. In addition, if the notice is given during the first ten years after full operation of the generating plant, AEC will be required to pay certain cancellation costs. The amount of cancellation costs will decrease each year.

The annual costs of power when the plant is in full operation is currently estimated at about $60,000,000. The power costs to AEC will be based on fixed charges and costs of the power-generating facilities, operating expenses, and fuel.

The AEC also announced approval of an agreement with Electric Energy, Inc., a group of five private power companies, to supply an additional 235,000 kilowatts of power for the operation of the AEC's uranium-235 production plant now under construction near Paducah, Ky. Total power requirement for the AEC's Kentucky plant is 1,940,000 kilowatts.

The new agreement increases the total power to be supplied by Electric Energy, Inc., from 500,000 kilowatts to 735,000 kilowatts. The 235,000 kilowatts represent 25 per cent of the additional power required by the expansion program at the gaseous-diffusion plant in Kentucky. The Tennessee Valley Authority will furnish the remaining 75 per cent of the new requirement, 705,000 kilowatts. TVA will supply a total of 1,205,000 kilowatts.

The agreement covers a 25-year period with extensions available for the Atomic Energy Commission. The immediate liability of the AEC extends to August 1, 1953, prior to which time the Commission will request from Congress an increase in the limitation on its authority to incur liabilities for cancellation charges under power contracts.

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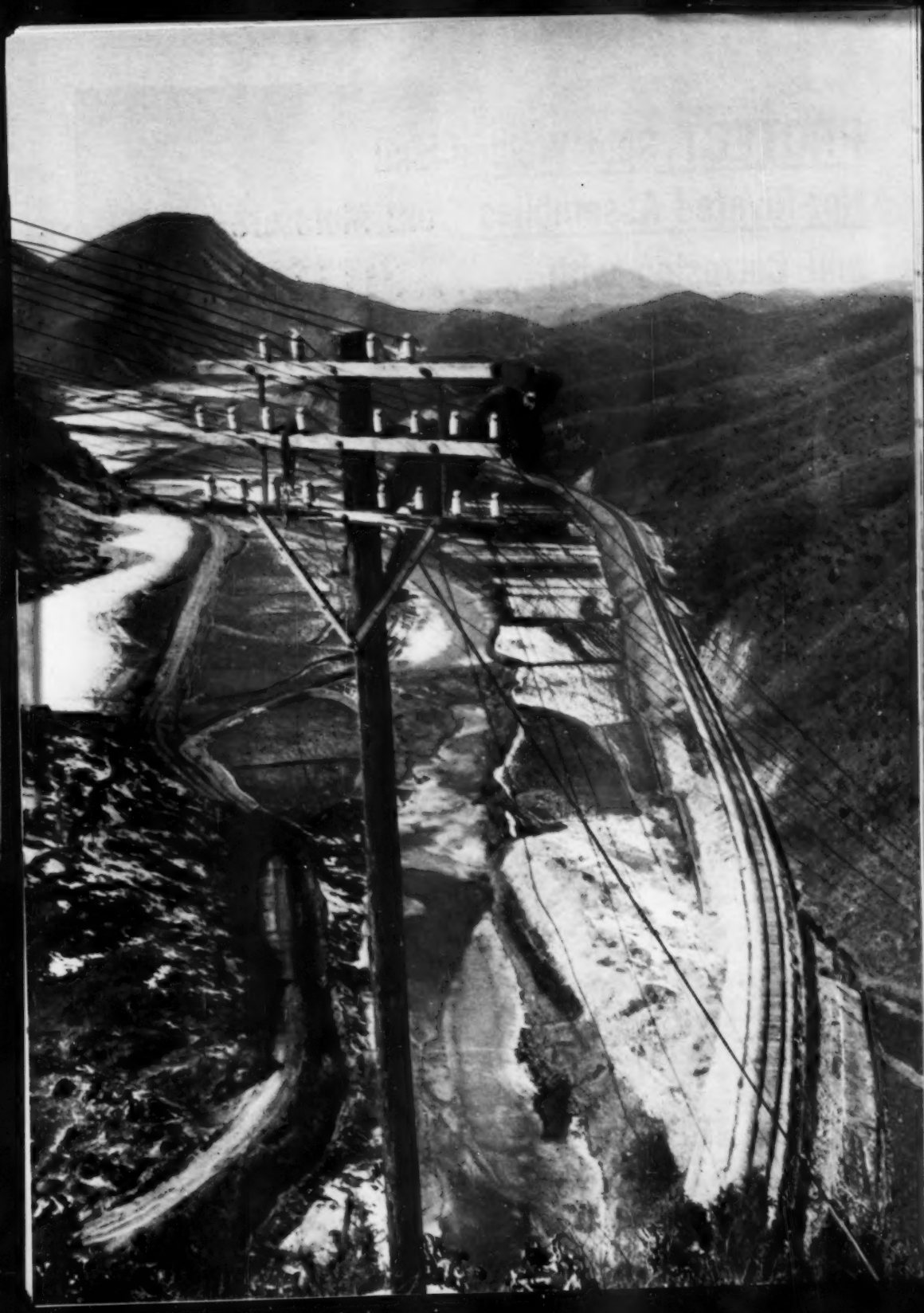


Production Line Preparedness

Industrial Leadership in the Department of Defense

SINCE the formation of the Department of Defense when the three military services were brought under single direction in 1947, there have been four distinguished Secretaries of Defense, each of whom was outstanding in special fields and all of whom contributed in a major way to the evolution of our new defense philosophy and the administration of new principles.

Devotion to Defense

The life work of the late James E. Forrestal, first Secretary of Defense, was characterized by intense devotion to the realities of defense problems. In civilian pursuits he had been a distinguished financier whose wartime service with the Navy gave him unique understanding of the problems and responsibilities of our American sea power.

Col. Louis Johnson, Mr. Forrestal's successor, brought to the office of Secretary of Defense long experience in the law and in industrial mobilization planning with special emphasis upon Army problems, particularly as they relate to the technical responsibilities of design and procurement of military equipment.

Gen. George C. Marshall, our third Secretary, was strictly the soldier, his long military career having been devoted almost exclusively to the strategic and tactical concepts of our Army to which his contribution had been of far-reaching effect.

Robert A. Lovett, until recently our fourth Secretary of Defense, brought to the office the prudence and good judgment which are part of a successful career in banking supplemented by special knowledge of the problems of our air arm, having served as the Assistant Secretary of War for Air during the major part of World War II.

Each of these leaders contributed in a unique way to the progress of our defense philosophy and each gave unstintingly of his talents toward the formation of the new administrative techniques of defense. In the short span of six years the Defense Establishment has been led by talented leaders in various fields except that of actual assembly-line experience.

During this period the Korean war brought serious strains on our national economy even before the National Security Act had time for adjustment to peacetime, much less wartime, problems. Secretary Lovett's final report has indicated needed revisions in the defense organization, notably in the structure of the Joint Chiefs of Staff; the need for returning Army staff operations to the strict planning level and away from growing encroachment in the field of military procurement, production, and other operating functions.

Industrialist's Viewpoint

With the advent of Charles E. Wilson, the industrialist's experience and point of view are at the helm of the Defense Department for the first time in its brief history. His will supplement the experiences which have preceded it and will be marked undoubtedly by a realistically practical approach in which production goals, manpower utilization, balance sheets in black, direct action, and long-term efficiency and economy will be paramount.

He presented his proposal for dual-purpose plants to the members of the American Ordnance Association, of which he is a life member, at their annual meeting in 1951.

Thus we enter upon a period in our defense philosophy when assembly-line preparedness comes to the fore, both as to its capabilities in hot as well as cold war and in the hoped-for long periods of peace in between.

Charles Erwin Wilson, the new Secretary of Defense, whose photograph appears on the front cover of this issue, has had an extensive industrial experience as the chief executive officer of one of the world's largest corporations.

During World War II, General Motors Corporation, of which Mr. Wilson was president, did $12 billion worth of business with the United States Government and was thus one of the major production agencies in arming our own Nation, and the free nations of the world, against aggression.

Mr. Wilson was born at Minerva, Ohio, July 18, 1890. He was graduated with a degree in electrical engineering from the Carnegie Institute of Technology in 1909 and secured his first job with the Westinghouse Electric & Manufacturing Company.

In 1919 he began his first association with General Motors Corporation as chief engineer and factory manager of the Delco Remy Company, a General Motors subsidiary. In 1926 he became president of Delco.

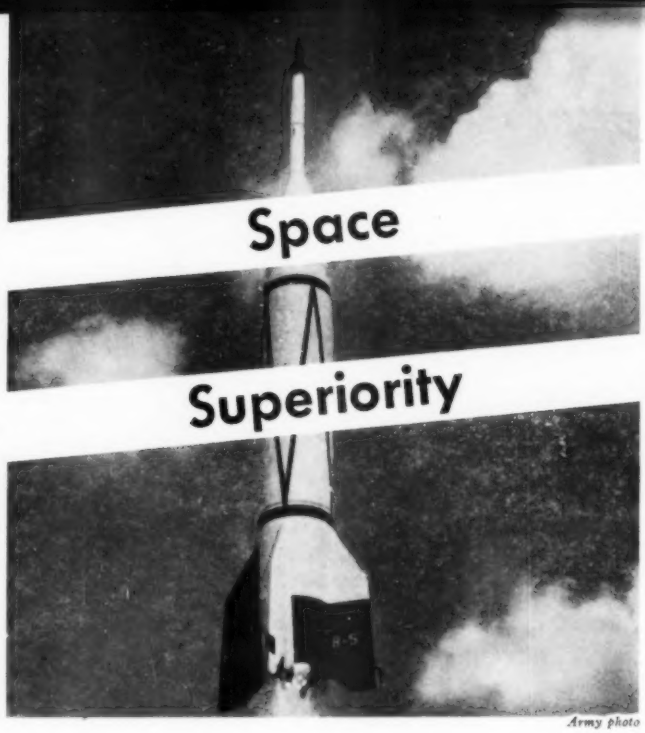
In 1929, Mr. Wilson became vice-president of General Motors and served the corporation in this capacity for ten years. In 1934 he became a director of the corporation and in 1939 was named executive vice-president.

With the spread of World War II to the United States, Mr. Wilson was named president of General Motors and, at the conclusion of hostilities, was designated chief executive officer of the corporation.

In 1951 Mr. Wilson was awarded the Charles L. Harrison Gold Medal for Distinguished Ordnance Service by the Cincinnati Post of the American Ordnance Association.

ON THE WIRE.—*A lineman of the 4th Signal Battalion works to keep communications open high above Korea's rugged terrain (Army photo).*

Space Superiority



Army photo

by

Dr. Wernher von Braun

THE most distinguished military thinking of our time concedes that the only way to win a third world war is to prevent its outbreak.

The statesmen of our country have made every conceivable effort to ease the tensions arising from the dislocation of the balance of power which followed World War II, but their labors at the conference table continue to be bitterly disappointing.

Force Necessary

The net result of all the talk is a very expensive realization that there is only one way in which a treaty with the dictators of the East can be made to stick; namely, to back it up with enough force to compel its observance.

Thus the West finds itself obliged to arm to the teeth in the interest of maintaining an uneasy peace in this tortured world, and the United States bears the major brunt. In rearming ourselves we face a double problem. The first is to create a *deterrent power* which shall be sufficiently effective to inhibit the East from continuing its aggressive expansion ending in all-out war.

Secondly, we must build up *fighting power* so that we may have the best prospects for success—and minimum destruction in our own and allied countries—if global war cannot be avoided. In the light of the introductory statement—credited to General Marshall—that to prevent such a war is to win it—it is only logical for the United States to give first priority and immediate, maximum attention to creating and making effective the deterrent power.

Effectiveness Uncertain

At the present time our deterrent power depends upon the combination of atom bombs and strategic bombers of long range. There is, however, considerable uncertainty as to just how much longer that combination will remain effective. The mere possession of atom bombs by the Red rulers will not render Red nerve centers and nerves less vulnerable to our bombs, but the question is whether our global bombers will be able to reach their targets when the time comes, if come it does.

We know that the Communists are vieing with us and other Western nations in the development of new and effective ground-to-air guided missiles which could make the life of a heavy bomber crew anything but a bed of roses.

The atom bomber may have been the "ultimate weapon" heretofore, but this will not be the case much longer. Like the battleship, the atom bomber will become just another weapon, capable indeed of playing an effective rôle in war, but its deterrent power is on the decline. The handwriting is on the wall.

Deterrent Power

Winston Churchill thinks that the uneasy peace the world has enjoyed since 1945 has been due to the deterrent power exercised by strategic bombers with their capacity for delivering atom bombs anywhere they might be needed. It was this country's statesmen, industrialists, engineers, designers, scientists, workmen, and airmen who had the vision, the industry, and the initiative to bring that deterrent to a third World War into being. And I might include the taxpayer, without whose contribution the enormous financial requirements of the strategic-bomber concept and the atomic program could not have been met.

"Ultimate Weapon"

It is now the time, however, when we must relegate strategic bombing to a secondary position and seek a new "ultimate weapon" which shall preferably not only return to us that deciding "edge" we once had over Red aggression but likewise be kinder to the taxpayer and be able to contribute something constructive to the world whose uneasy armistice we hope it will successfully transmute into permanent peace.

It should be rather plain that there is but little use in "wildcatting" in the well-nigh exhausted oil fields of con-

ventional armament. The deepest hole we can sink will at best bring no gusher but rather some little trickle encouraging our prospective opponent to outdo us with his totalitarian command of engineering talent and his hordes of slave labor.

We must find our deterrent to a third world war in new horizons: in a field where test drillings have already revealed a plentiful supply of the treasure we seek. Not only does it promise this but also incalculable benefits after its purpose of preventing war shall successfully have been accomplished. The field to which I refer is that of rocketry.

Rocketry is, I believe, capable of solving the world's peace problems more effectively than any other branch of science and engineering and simultaneously—that is to say, without additional expenditure—doing a great deal for the advancement of mankind. Let me give you a few highlights on what has been done in the field since some well-nigh prehistoric Chinese touched off the first primitive powder rocket. It's a far cry, indeed, from that to the German V-2 which represents the longest single stride the science has made.

Principle Well Known

In this connection, it is a mistake to think that the basic concept—either in science or technology—of the long-range liquid rocket originated in some secret German laboratory. The principle was a familiar one throughout the international technical literature long before the war. The V-2 came simply as the result of devoting sufficient practical engineering effort to the "hardware stage" of a well-known principle.

Also the V-2 and its postwar fellow rockets constitute but very modest examples of what can be accomplished with this principle along technical, scientific, and military lines. We need fear no fundamental, immovable roadblocks along the path of further development of the large liquid rocket, for the principal difficulties have already been conquered. At some distance along this path—a very attainable distance, by the way—stands the multi-stage, orbital rocket ship bearing a crew out beyond the stratosphere.

The first nation to launch such a rocket ship will possess, in my opinion, what may well be the long-sought "ultimate weapon." But beyond that, and once it has fully exerted its deterrent effect upon would-be aggressors, it will be capable of serving an infinitude of scientific—that is to say humanitarian—ends.

The drawing on page 772 shows a liquid rocket some 265 feet in height. Let it be 65 feet in diameter and weigh 7,000 tons—about the same as a light cruiser. The rocket's tanks will be loaded with 6,150 tons of hydrazine and nitric acid—just about half a full load for an average tank steamer.

In Three Sections

This enormous rocket ship will be made in three sections, one atop the other. The bottom section is the first booster stage. It will have 51 rocket motors giving an upward thrust of 14,000 tons. Under this thrust, the whole ship will begin to move slowly, majestically upward. When it reaches a few thousand feet, gyroscopes will actuate its controls so that the path of ascent tilts over toward, but not reaching, the horizontal. Eighty-four seconds after take-off the propellants of the first stage exhaust themselves, having brought the ship up to a velocity of 5,265 miles an hour at an altitude of 24.9 miles. The angle of climb will be 20 degrees above the horizontal.

The now empty booster stage drops off and the rockets of the second booster stage ignite, imparting to the ship a velocity of 14,364 miles an hour during the ensuing 124 seconds. The angle of climb will be down to almost the horizontal—just 2½ degrees above the latter, and the altitude will have increased to 39.8 miles. Now the second-stage propellants are exhausted and the stage is dropped.

Dr. von Braun served as technical director of the German Liquid Fuel Rocket and Guided Missile Center at Peënemuende from 1937 until the end of World War II. Since that time he has been associated with the U. S. Army Ordnance Corps. At present, Dr. von Braun is technical director, guided missile development group, Redstone Arsenal, Huntsville, Ala.

18,468 Miles an Hour

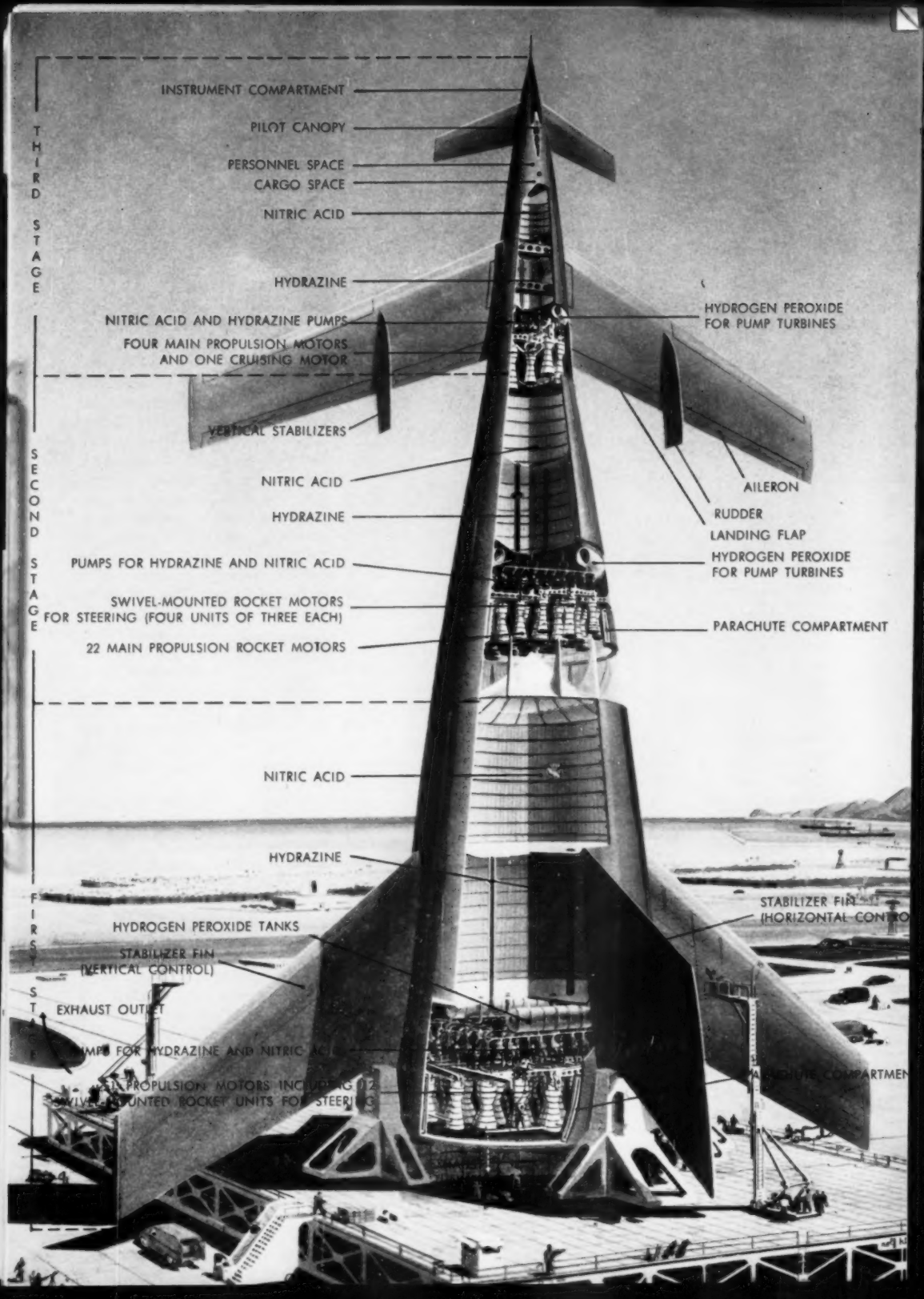
The third stage—in appearance not unlike an airplane—continues under the 220 tons of thrust exerted by its 4 rocket motors and bearing cargo and crew. It reaches a velocity of 18,468 miles an hour just 84 seconds later and is in horizontal flight at an altitude of 63.3 miles.

There is still ample fuel for the motors to continue their thrust, but they are shut off by the automatic action of an integrating accelerometer—a special speed-measuring device. The rocket ship now coasts throughout the major portion of its voyage.

Since 18,468 miles an hour is somewhat higher than the so-called "circular velocity" at an altitude of 63.3 miles, the ship will recede from the earth. At "circular velocity" it would continue to circle the earth at a distance of exactly 63.3 miles—just as if it were another, smaller, much closer moon. But since there is still some air drag at this altitude (sounding rockets have already been there), the ship would lose its speed after a while and would have to glide back to earth on its wings.

In order to avoid an involuntary landing of this nature, we set the integrating accelerometer to cut off the power at a velocity somewhat higher than the circular velocity at that altitude. Thus the centrifugal force at right angles to the flight path exceeds the attraction of gravity slightly and the laws of celestial mechanics decree that the ship enter an elliptical path which carries it farther and farther out into space. After the ship has gone halfway around the earth it reaches the highest point of the ellipse—the so-called apogee—at 1,075 miles of altitude.

During this unpowered climb, which takes 51 minutes, gravity will have been working on the vessel and will have reduced the speed from 18,468 miles an hour to 14,770, which is a bit


THIRD STAGE
SECOND STAGE
FIRST STAGE
INSTRUMENT COMPARTMENT
PILOT CANOPY
PERSONNEL SPACE
CARGO SPACE
NITRIC ACID
HYDRAZINE
NITRIC ACID AND HYDRAZINE PUMPS
FOUR MAIN PROPULSION MOTORS AND ONE CRUISING MOTOR
VERTICAL STABILIZERS
NITRIC ACID
HYDRAZINE
PUMPS FOR HYDRAZINE AND NITRIC ACID
SWIVEL-MOUNTED ROCKET MOTORS FOR STEERING (FOUR UNITS OF THREE EACH)
22 MAIN PROPULSION ROCKET MOTORS
NITRIC ACID
HYDRAZINE
HYDROGEN PEROXIDE TANKS
STABILIZER FIN (VERTICAL CONTROL)
EXHAUST OUTLET
HYDROGEN PEROXIDE FOR PUMP TURBINES
AILERON
RUDDER
LANDING FLAP
HYDROGEN PEROXIDE FOR PUMP TURBINES
PARACHUTE COMPARTMENT
STABILIZER FIN (HORIZONTAL CONTRO

less than the "circular velocity" corresponding to the apogee. If we wish the rocket ship to remain at apogee height, we must augment its speed enough to bring it up to the "circular velocity"—15,800 miles an hour. Accordingly, the rocket motors are operated long enough to make up the difference and increase the speed by 1,030 miles an hour.

Now our rocket ship will be circling the earth at a height of 1,075 miles at a speed of 15,800 miles an hour—just a little over 4 miles a second. It will take two hours to make the full circle and will require no power whatsoever. Furthermore, it will remain in this orbit indefinitely.

We have selected the orbit's plans in such a manner that its most northerly point passes over the Arctic Circle and the most southerly point just crosses the Antarctic Circle. This orbit is intermediary between an equatorial one and one which crosses the poles, and for a very good reason. The movement of the rocket ship in its orbit and the rotation of the earth so combine that there is no point on the earth's surface which cannot be observed from the rocket ship at least once every twenty-four hours—unless that point lies within the Arctic or Antarctic Circles.

Herein lies the key to military space superiority, for nothing but isolated outposts of an enemy can lie within the Arctic and Antarctic Circles, and the capabilities of rocket ships and vehicles extend far beyond mere observation, as I shall show.

36-ton Pay Load

The pay load of the rocket ship we are considering is about thirty-six tons —equivalent to that of two of the new Super Constellations. During any single trip to the orbit these thirty-six tons of pay load can be discharged there and will remain circling when the plane-like third stage actuates its rocket motors and returns to the atmosphere to make a conventional airplane landing.

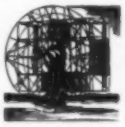
The two booster stages will have expelled retarding parachutes made of woven wire after their propellants have been exhausted and will have landed in the ocean where their empty tanks will have kept them afloat until salvaged. Thus any rocket ship can be reassembled, refueled, and relaunched an indeterminate number of times.

A modest number of such orbital rocket ships can haul into their orbit sufficient material and components to build a permanent station there—an artificial satellite.

Such an artificial satellite would preferably be built in the shape of an enormous wheel and would rotate slowly around its axle. Within its rim this rotation would generate sufficient centrifugal force to simulate the effects of gravity, rendering life far more comfortable for the inmates than if they were exposed for extended periods to the weightlessness otherwise existing in the orbit.

The satellite would be designed and built in segments of nylon-reënforced plastic. One or more segments would be loaded into a rocket ship in the uninflated condition, much as rubber life rafts are loaded into airplanes. Men in pressure suits would assemble the segments in the orbit, and, when the wheel was complete, it would be inflated from air tanks like an automobile tire.

Of course the satellite would have its own air-conditioning system which would renew the oxygen consumed by the crew and fulfill the other requirements necessary to provide them with an ample supply of healthy, breathable air. For this purpose, there would be a periodic visit by a rocket ship to provide not only oxygen, but food, water, and other necessities.



Temperature control of the interior of a space station may be obtained by regulating the ratio between heat absorption from the sun and heat radiation into space. This is easily done by "radiation shutters." Electric power for the station may be drawn from a solar reflector generating steam in a boiler tube connected to a turbogenerator. Such a solar energy plant is far more efficient in cloudless space than within the shell of the atmosphere.

We calculate that a satellite station 250 feet in diameter could accommodate a crew of between 200 and 300 men. It would weigh about 400 tons and could therefore be set up in the course of 12 to 14 rocket flights to the orbit.

Military Uses

The first and obvious military application of such a station is that of reconnaissance and observation. One or more 100-inch reflecting telescopes like that on Mount Wilson will be used. They will not be in the station itself, but will float freely in space a few hundred feet distant from it in the same orbit.

Cameras like those used in aërial surveying will automatically take reconnaissance pictures, being bracketed on their subjects by reaction flywheels radiocontrolled from the outstation. The field of view of the camera will be checked from within the station via television screen, while the camera shutter will be tripped by radio. Plate transfer will be automatic.

A single telescope can make 100 exposures during the 2 hours it takes the station to circumnavigate the earth—more than 1,000 a day. The negatives may be evaluated either in the outstation or they may be sent to earth on the weekly supply rocket ship. Immediate televising of results to earth is also within the range of possibility.

The resolving power of a 100-inch reflecting telescope at a distance of 1,075 miles is about 16 inches: that is to say, it can distinguish objects 16 inches apart at that distance. This is equivalent to the capabilities of the naked eye at a distance of 5,000 feet.

Improved Radarscope

The station would also operate improved radarscope equipment far superior to present aircraft-borne devices and thus be able to penetrate reliably the thickest cloud overcast.

An orbital reconnaissance station can pull up any iron curtain!

Drawing of the proposed 3-stage rocket which would be used in setting up a satellite station in space.

But reconnaissance is but the first of the military applications for our outstation in space. While we may well hope that its mere existence would seriously discourage any large-scale military moves, it has far greater potentialities. When it comes down to cases, the outstation is also a launching platform for orbital missiles against which there cannot well be countermeasures. If we fire an atom-tipped, winged rocket backward from the outstation so that its thrust diminishes its orbital velocity relative to the station by 1,070 miles an hour, it will succumb to gravity and approach the earth on an elliptical path. The speed reduction of 1,070 miles an hour is such that the missile will reënter the atmosphere tangentially at a perigeal altitude of 50 miles and halfway around the earth from its point of firing.

Controls Automatic

Upon entering the atmosphere, its automatic controls will so actuate the control surfaces as to prevent its slipping back elliptically to the apogee in the orbit, which it would otherwise do.

An application of a barometric altimeter will depress the flippers to give the wings a negative angle of attack and this will hold the missile at the perigeal altitude. Then air drag will slow it down below the local "circular velocity" so that it finally enters a supersonic glide with positive angle of attack.

The missile will reach its perigee nine minutes earlier than the outstation reaches a point directly above this perigee. This means that the missile outdistances angularly the outstation, despite having been fired backward from the latter.

Second Orbital Station

Thus, if we establish a second much smaller orbital station 2,400 miles ahead of the principal one (near which the missile is sent on its way), the missile will be within the field of observation of the second station during the whole of its supersonic glide—as will be the target somewhat later.

The second satellite station can follow the missile by radar and also correct its course by radio remote control. The target itself will enter the field of view of the controlling station some minutes before the missile reaches its objective on ground or ocean. A target line of sight will thus be established either optically or by radar. The missile-tracking radar gear will establish a second line of sight between control station and missile.

Computers in the control station similar to those used for antiaircraft guided missiles will compute the desired relationship between the two lines of sight so that the target line of sight and the missile line of sight will coincide at the moment of impact and the flight of the missile will be aërodynamically corrected by radio remote control from the station to bring this about.

> *"We need fear no immovable roadblocks along the path of further development of the large liquid rocket . . . At some distance along this path stands the multistage, orbital rocket ship bearing a crew out beyond the stratosphere. The first nation to launch such a ship will possess, in my opinion, what may well be the long-sought 'ultimate weapon'."*

Extreme accuracy of the missile is thus assured, and it is likewise possible to detonate the atomic warhead exactly above the target and while the missile is still moving at high supersonic speed. Countermeasures appear to be wholly ineffective under those conditions.

One of the main advantages of orbital missiles is their absoluteness, so to speak. There they are in the sky—visible to the prospective enemy but unreachable by him—a sort of sidereal arsenal. We hope we won't have to use them, but we want the maximum of deterrent effect combined with the maximum destructive effect if worst comes to worst.

Millions of people all over the world would become aware of this tiny man-made constellation whipping across the skies and visible to those who knew where to look during the hours of dawn and dusk when it would glitter in the sun. For the peace-minded it would represent an ever-present guardian against war and the usurpers of power would constantly be reminded that they would sow world discord at their own peril.

Vulnerability

What about the vulnerability to attack of an artificial satellite? Are we justified in calling it a space fortress, or, as some people say, might it be destroyed from the ground at far less cost than it took to establish it in its lofty eyrie? We should remember that the same question has often been raised with respect to bombing aircraft, aircraft carriers, and tanks. In the light of my own strictures on the vulnerability of the transsonic bomber and my claims that the orbital station is the "ultimate weapon," the question of vulnerability is cogent.

There seem to be two conceivable methods of attacking an orbital station which will bear investigation of a closer nature. One of these involves firing upward a rocket which would discharge in the orbit of the station a load of shrapnellike objects into which the station would move at the rate of 15,800 miles an hour.

If it were possible to make a "hit" with such an unmanned rocket, we might well suffer a few "bullet holes" in the station. With puncture-proofing techniques such as applied in bullet-proof tires and with compartmentation we can provide some protection. Nevertheless, an interceptor rocket cannot be entirely discounted.

But let us not forget that an error in timing of the interception of one second would amount to four miles in distance, due to the velocity of the station. Even an atomic warhead on such an interceptor missile would be relatively ineffective to increase its radius of destructiveness, for the pressure wave produced by an atomic explosion is nonexistent in a vacuum.

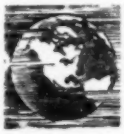
Another possible method of attack is, of course, a manned rocket ship with rocket artillery. Any such space vessel would simply be carrying presently familiar forms of air combat out beyond the atmosphere and there is no doubt whatsoever that in such a case the victory would go to the side which made the first hit. We cannot doubt that a space station is vulnerable to such an attack, if it be presumed that the prospective enemy has been allowed to develop his rocketry at the same rate as we.

Ground Installations

In order to set up an outer station, we must first build very extensive ground installations. They will consist of elaborate take-off or launching sites, great plants for building and testing rockets, special factories for the necessary chemicals, ships for retrieving boosters, and much more. These, not the station itself, are the things to attack.

If we can get our ground establishment set up and working and establish our artificial satellite with its space-to-ground missiles ready for action, we can stop any opponent cold in his attempt to challenge our fortress in space! The space station can destroy with absolute certainty an enemy space craft prior to its launching.

But far better would it be if we could say to the enemy a determined, power-packed "No!" when he is only beginning his development of manned space craft! And still better if we can forestall his building of ground installations. I believe that there is still time for us to accomplish this, and I urge that it be done!



Scientists Dubious

There are some scientists and engineers who do not at all question the feasibility of manned space ships, yet who believe that it is too soon to tackle an all-out space program. Their explanation of this Fabian attitude is that the time is not yet ripe. They claim that the conquest of space—whether for military or scientific ends—will come as a sort of natural by-product of the many-branched development of supersonic aircraft and guided missiles which is now taking place in this country.

I do not share this point of view at all, and I want to point out that when the Manhattan Project was started a lot of people screamed that the time wasn't ripe for the atom bomb.

On the other hand, there were foresighted men who dared to take the vital step because they knew full well that, if an atom bomb could be built at all, it could never become a reality as a by-product of the academic studies on nuclear physics being carried on at various schools and colleges.

Problems Fewer

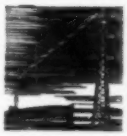
I would not be surprised if a good many readers were to consider the building of enormous, man-carrying space vessels and using them to set up a space station as somewhat on the risky side—maybe you would even call it fantastic. But let me assure you that we who advocate it are faced with far fewer basic problems than were the men who undertook the atom-bomb development back in 1940!

I am not claiming, mind you, that building a space station is as simple as putting a new automobile, or even a new jet aircraft engine into production. It is far more than that—it is one of the greatest engineering problems of the age. We must expect many a setback and many a heartbreak, but setbacks and heartbreaks are part and parcel of any courageous, far-sighted engineering effort.

Now for an estimate of the time and money required to make the effort a reality: If this project is undertaken without delay, if it is pursued resolutely, if it is pushed to the ultimate, then it can be completed far enough to have a recognizable military value within ten years and at a cost not to exceed four billion dollars.

By undertaking it without delay, I do not mean that we should immediately undertake the "hardware stage" of manned rocket ships. The first thing we ought to do is to set up a study schedule—costing at most a couple of million dollars—which will take under advisement each and every phase of the problem and present comparative studies of the various factors and elements entering into it.

Let me give an example of the sort of thing I'm talking about: If we can standardize the motors in the three stages of the ship, we shall save a great deal of time and money when we do reach the "hardware stage," and we shall cut down a great deal on the testing facilities which would otherwise be required.



Prior to designing and building manned orbital rockets, it is surely good sense to develop relatively small, multi-stage rockets and to fire them upward into the orbit, thus overcoming in miniature many of the practical problems which otherwise would beset the full-scale space ship.

We may take some pretty long steps in our development program without fear of their being actually reckless. When we fired the first V-2 rocket during the summer of 1942, it seemed perfectly gigantic to us alongside the kind of thing which was then common. But the step we took in building and firing that rocket was anything but reckless, as subsequent events proved.

Money Needed

With what we know today about rocketry, with the state rocket technology has reached, I see no reason whatsoever why we shouldn't take another step forward of the same order of magnitude. There's no more problem to building a "bigger" rocket than there is to building a "bigger" airplane. It just costs more money.

Editor's Note.—This article represents the views of the author only and does not necessarily reflect the opinions or policies of the Department of the Army.

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U. S. Navy photo

Balanced Forces for the U. S.

Excessive "Preparedness" Might Cause Peacetime Disaster

By Hoffman Nickerson

ONE of the chief tasks confronting the new Administration is that of deciding what is a balanced force for the United States. In other words, how can our effort to prepare for possible war be best proportioned so as to prevent weakness in some particular item more than canceling out strength in other items?

Formulas Worked Out

In the eighteenth and nineteenth centuries those who spoke of a balanced force were concerned chiefly with the due proportions between the different parts of armies and navies. Within armies, regular mathematical formulas were worked out. An infantry force of given size was supposed to be balanced when accompanied by so many guns and sabers for each thousand bayonets. In highly mobile campaigns a higher proportion of cavalry was desirable; in siege warfare a higher proportion of guns.

In navies a balanced fleet had to include not only line-of-battle ships, or simply battleships, but also different types of lighter vessels which could economically accomplish missions for which maximum fighting strength was not required.

Another factor was the ease or difficulty with which this or that component of a balanced force could be improvised in time of war. For instance, battleships took a long time to build whereas dispatch boats could be built more quickly and could perhaps be requisitioned from civilian craft.

The balance between land and naval forces was always affected and usually governed by geography. In Austria and Russia, the navy was subordinate; in England, the army. At the same time national policy had to be considered.

Mr. Nickerson is an outstanding military historian and author of numerous works inciuding "Can We Limit War?" "The Armed Horde," "Arms and Policy," and "The New Slavery."

Until 1915, British national strategy needed land forces only to garrison relatively secure outlying possessions and to make sure that possible invaders of the home islands would have to come in some force in order to succeed, whereas in 1915 a mass army was considered necessary.

Decision Difficult

Deciding between army and navy requirements became difficult in cases when either necessity or deliberate national policy required great efforts by both land and sea. For instance, in the seventeenth and early eighteenth century naval strength was as essential to England as it is today, and it was also essential to Holland because the wealth of both countries depended upon overseas trade. But England, being an island, had no land frontier to be defended whereas Holland could be threatened by land.

A variant of the same situation entered into the later rivalry between England and France because France

not only had land frontiers to defend but in addition was often attempting to expand in Europe as well as overseas.

In these difficult cases, governments and their military advisers had to decide what was the chief threat to their independence or to any other policy of theirs which was considered worth a war. As the French say: *Pourvoir toujours au plus pressé*—"Always provide against the most pressing or the most urgent need."

Apply Old Principles

Today the old principles must be applied to new questions as well as to the old ones. Air forces have been added to armies and navies, thus making the old tug of war between the services into a triangle besides raising the question of the balance within an air force as between the different types of planes, not to speak of rockets and guided missiles.

Finally the unprecedented and enormous authority of twentieth-century governments over the governed has moved the whole idea of balanced force into a new dimension. That authority has become so absolute that for the first time in history mere preparation for war without a great "shooting war" may so derange the whole national economy as to defeat through political and social disorder a nation which indulges in excessive "preparedness."

Limiting ourselves to the balance between civilian and defense spending and to the balance between the three services, after this rapid glance at the general principles involved we may now turn to our own concrete case.

Possible Enemies

The only group of potentially hostile governments which might compel us to large-scale armed effort within the near future is composed of the U.S.S.R., Red China, and the Red satellites in Europe.

In addition, elements of various Asiatic and African peoples inflamed against European colonialism, or at least against the bitter memories thereof, might create troublesome diversions if we were already engaged against the organized Red forces.

There are also groups of fanatical Communists and different sorts of Communist sympathizers in many if not most non-Communist countries.

As a means to an end of their repeatedly announced goal of world conquest the Reds have worked out a new form of international competition which is aptly known as "cold war." This has been developed from hints by the great military philosopher Clausewitz, especially from a passage in Chapter 3B, "Of the Magnitude of the Object of the War and the Efforts To Be Made," in Book VIII of his well-known work "On War."

In that passage Clausewitz discusses "the utmost extremity" of military exertion and concludes, "In most cases this attempt at an extreme effort would be wrecked by the opposing weight of forces within itself."

Internal Disorder

In other words, if one party in preparing for an expected conflict militarizes so much of its economy as to make life intolerable for any considerable number of its citizens while the second party does not commit this error, then internal social and political disorganization within the first party will set in. If this disorganization continues to grow, then the afflicted people may in the long run be defeated with little or no hostile military effort.

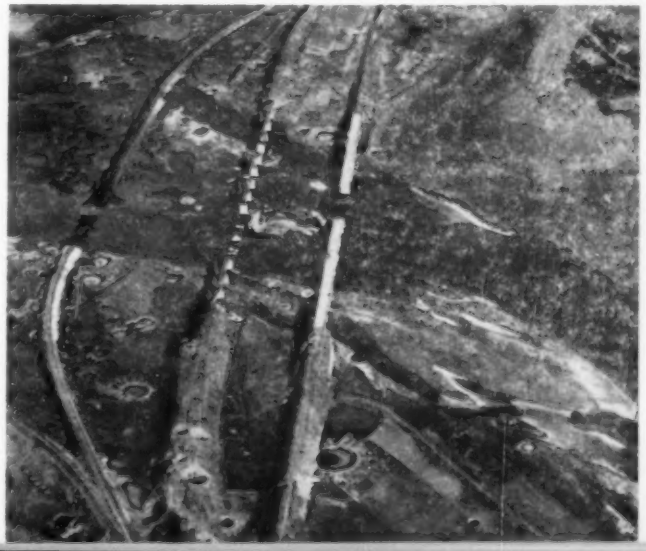
A human group staging an offensive cold war, in this case the Reds of the world centered in Moscow, needs highly organized armed forces but only for politically defensive missions. As yet the function of the Red armies, navies, and air forces of the world has been that of discouraging or deterring "preventive wars" of a conventional sort by the non-Communist governments; also that of keeping the threat of invasion hanging over the accessible non-Communist peoples.

Kept in Background

This threat, however, is kept in the background. The "marching wing" or offensive component of the Red cold war is composed of a continual series of political and diplomatic moves by the Red governments, together with the activity of trained agents and propagandist agitators who exasperate internal quarrels within non-Communist countries, foment strikes where they can do so, and threaten timid or exposed individuals who might oppose Communism politically.

All this is designed to harass and confuse the non-Communist peoples by what Clausewitz might have called "direct attacks upon opinion." This political war has been and is being supplemented by "shooting wars" too small and too indirectly connected with Moscow to provoke the non-Communist powers into all-out armed attack upon the Soviet Union.

Below, a demolished bridge complex near Sinp'o testifies to the accuracy and the effectiveness of pin-point bombing activities in Korea.
U. S. Navy photo



This method has been tried in Greece and is being tried in Malaya, Indo-China, and Korea. In every case the objective has been the same: to wage war cheaply and at the same time to compel the non-Communist powers to comparatively heavy expense in manpower and especially in money, which is an index to the amount of goods and services required.

Liberties Relinquished

We should admit frankly that considerable successes in this direction have been achieved against us. Even in the United States, which is in a material sense the citadel and powerhouse of opposition to Communism, we have felt compelled to give up certain of our liberties in order to resist what the Reds have been doing and may do next. We compel an appreciable number of our young men to serve in arms, and we lose control over the considerable part of our individual livelihoods which is taken from us by confiscatory taxes.

This is not the place to discuss what form our political warfare should take, or how we might more cheaply and effectively deal with the small wars which the Reds have started, or even whether we should allow them to expand at will in Europe and Asia in the belief that no amount of Communist murdering and exiling of their political opponents could prevent the increase of their political difficulties and internal quarrels as Communist-governed territory went on expanding.

Limit to Spending

We are here concerned only with Clausewitz' point that there is a practicable limit to military spending. In a word, military and civilian spending must be kept in balance.

The point may be made clearer by a few extreme examples. Obviously there is an absolute limit to the amount which any human group can divert from productive to military purposes. Fighting men on active service cannot make a living by agriculture or by any other means. A war party of savages who have eaten the food in their pouches and cannot capture some accumulated stock must break off operations either to hunt game or to return to camp where their women and sufficiently grown children have presumably been doing what they could to produce or collect food against their return.

"The unprecedented and enormous authority of twentieth-century governments over the governed has moved the whole idea of balanced force into a new dimension. That authority has become so absolute that for the first time in history mere preparation for war without a great 'shooting war' may so derange the whole national economy as to defeat through political and social disorder a nation which indulges in excessive 'preparedness'."

In civilized societies, a city in which all full-grown males had to go on permanent, full-time police duty would presently starve.

Further, in civilized societies there is, far below this absolute limit, a practicable limit. Long before widespread starvation begins—often before there is any starvation at all—excessive militarization begins to jam the complex economic processes by which a high material civilization is carried on.

Is It Worth While?

If sacrifices which the citizens consider too great are too long demanded of them they begin to wonder whether the war effort is worth while and whether a victorious enemy will injure them more than their own government is already doing. Finally the war effort breaks down.

This practicable limit of military spending and of military effort in general is elastic because it depends upon public opinion and upon the extent to which the government can control the governed. In 1918 the Germans surrendered without being invaded because they believed the implied promise made by President Wilson that a republican Germany would receive comparatively mild terms of peace, while in 1945 they fought until most of their country had been occupied.

The National Socialist party had a firmer grip on them than had William II, but also the "unconditional surrender" slogan of their enemies left them little to hope for. When public opinion is likely from the beginning to prove unequal to the strain of war, then governments will do well to keep the peace.

Morale Lowered

For instance it now appears that in 1939 the French politicians would have been wise had they avoided war, since a number of causes, culminating in the antics of Leon Blum and his "Popular Front," had so lowered the national spirit that stubborn and prolonged effort could not be expected.

In our own case at the moment, with Americans actually fighting only in Korea as these lines are written in December 1952, the question of how much military effort will prove tolerable is chiefly one of spending.

Senator Taft whose experience, ability, and honesty no one will question has recorded in his book, "Foreign Policy for Americans," his belief that a total Federal budget, military and otherwise, of much more than seventy billions would be disastrous.

After all, we are supposed to be opposing Communism in order to preserve as much as possible of our personal liberties not only against the Reds but also against our own Government.

Whatever the limit of cold-war military spending should be, once some limit has been set the question then arises: How much should go to each of the three services? This again must be discussed in terms of money—the common denominator of goods and services.

At the same time we must ask ourselves the old questions: First, how can our possible enemies hurt us most? Secondly, what are the most effective means by which we can impose our will upon them?

A glance at any map of the world shows that our strategy must be primarily oceanic. Outside of Alaska and easternmost Siberia our organized forces and those of the Reds can make contact only after crossing thousands of

miles of salt water either in ships or planes. The amount of force which we could bring to bear outside the continental United States must therefore be limited by the effectiveness of sea and air transport.

At the same time, given our naval strength, the supreme military threat of invasion and occupation by hostile land forces does not exist for us as it does for our allies in continental Europe and Asia.

Blockade Difficult

Moreover, while that naval strength is maintained it will be practically impossible to blockade the continental United States closely enough, either by submarines or by other means, so as to cut us off from overseas access to strategic raw materials.

Hostile naval activity could hardly do more than interfere with our operations in European and Asiatic waters. The only serious threat to our home country is that of some form of long-range bombardment from the air.

Correspondingly, the only attacks which we could launch against any important Red center at the beginning of a third world war would be from the air.

If we were at all certain that long-range air bombardment might come anywhere near being decisive either against ourselves or in a comparatively short time against the Reds, that belief would settle the matter. Most defense spending would rightly go to the Air Force with the other two services getting only small percentages.

In fact, however, expert opinion is so divided as to the chances of such bombing being decisive that, while we must fear it for ourselves, we must not be too hopeful as to its effectiveness against the Soviet Union.

Bombing Indecisive

For instance, Dr. Vannevar Bush, a high authority, thinks that such bombing is unlikely to be decisive. Moreover the bombing propagandists are suspiciously like schoolboys who, after losing a football game, are always saying, "Wait until next year." For them there is always "pie in the sky." In the next great war, so they keep telling us, all obstacles will be vanquished, and the strategic air forces of the world, armed with the new explosives, will come into their own.

In cases of uncertainty on the highest national level, the only wise course is to play safe by assuming that hostile operations against ourselves may prove a little more and our own operations of the same sort a little less effective than we think probable.

Useful Diversion

This means that defense against long-range bombing should be given a high priority, that such bombing by ourselves should be considered chiefly as a useful diversion, and that the functions of the Navy and Army in seizing and holding advance bombing bases and in denying such bases to possible enemies should not be neglected.

All political considerations tell strongly against bombing hostile cities. A military decision over the enormous territorial block of Communist-governed states can hardly be expected unless considerable parts of the populations subject to Communist rule can be persuaded to come over to our side.

To cite the nastiness of attack on civilian populations is not meant to disparage the courage and skill of our airmen but only to show the vile results inseparable from bombing cities. To say that Communists themselves are ruthless people or that horrible things have happened in all wars is true but irrelevant. Atrocities committed by unrestrained individuals are very different from those which must necessarily follow policies deliberately determined upon by high authority.

Direct hit on enemy marshaling yard at Hunyung on Manchurian border in Korea. *Navy photo*

Even in the increasing ethical barbarism of twentieth-century wars the wholesale killing of noncombatants, including babies—which must happen where cities are bombed—is a disgusting business. Consequently, to the extent to which we employ that disgusting method by just so much we shall make more difficult our real object, which is the winning over of peoples now subject to Communist rule.

In conclusion, our balance of forces should depend upon an over-all strategy based upon sea power plus the gaining of local air superiorities. The Army in any case must come third during the cold war.

Size of the Army

How large an Army we should raise will depend upon the amount of ground we mean to hold or help to hold in Europe and Asia from the beginning of possible hostilities. Obviously, with our population of 150 millions and with the unwillingness or inability of our allies to raise mass armies, large American campaigns on the Eurasian mainland against a Communist block with a population outnumbering ours by about seven to one are out of the question.

In Britain, the raising of mass armies in addition to great naval and air efforts has impoverished that country, which is a warning.

A predominantly sea and air strategy will by no means condemn us to a permanent defensive. The last three great conquerors, Napoleon, Kaiser Wilhelm, and Hitler, all found it politically necessary to undertake offensives which added to the numbers of their enemies until decisive counter-attacks became possible. If the Red leaders start shooting in a big way they will be similarly driven forward.

The Secretaries of the Armed Forces

Serving under Charles E. Wilson, the new civilian Secretaries of the armed forces have now taken their posts. They are: Robert Stevens, Secretary of the Army; R. B. Anderson, Secretary of the Navy; and Harold E. Talbott, Secretary of the Air Force.

• **Robert Stevens,** new Secretary of the Army, was born in Fanwood, N.J., on July 31, 1899. He was graduated from Yale University in 1921, when he entered the employ of J. P. Stevens & Company, textile manufacturers, becoming chairman of the board in 1945.

Mr. Stevens was a 2nd lieutenant of field artillery in World War I. In the Second World War he served as a colonel in the Office of the Quartermaster General and later as deputy director of purchases. He attended the Command and General Staff School. He was awarded the Legion of Merit and Distinguished Service Medal. In 1952 Mr. Stevens served as a regional civilian aide to the Secretary of the Army, Frank Pace, Jr.

• **R. B. Anderson,** Secretary of the Navy, was born in Burleson, Tex., on June 4, 1910. He was graduated from the University of Texas with an LL.B. degree in 1932. Elected to the Texas Legislature in that year, he held numerous other positions in the State government including the offices of assistant attorney general and chairman of the State Board of Education.

Mr. Anderson had been manager of the W. T. Waggoner Estate, Vernon, Tex., since 1941. He was also a director of the Texas Industrial Conference, deputy chairman of the Federal Reserve Bank of Dallas, and member of the National Manpower commission. Mr. Anderson was also a director of the American Petroleum Institute.

• **Harold E. Talbott,** a pioneer in aircraft production, is the new Secretary of the Air Force. A native of Pottstown, Pa., he was graduated from Yale in 1911 and entered the construction field in Canada.

In 1916 Mr. Talbott became president of the Dayton-Wright Company for the construction of airplanes and was also general manager of the Dayton Metal Products Company. He has been closely associated with the direction of many leading companies in the aircraft and automotive field.

In World War I Mr. Talbott was commissioned a major in the Air Force and in World War II he served for a time as director of Aircraft Production in the War Production Board.

Battlefield Verdict

by

George Fielding Eliot

United States infantry weapons pass the crucial test of combat in Korea

Army photo

EVER since the days of the Pennsylvania rifle, we have nourished an insistent idea that American soldiers should have the best weapons in the world. That is, of course, the natural military philosophy for a highly individualistic society such as ours. We have no manpower to waste. When we fight, we fight with citizen-soldiers. Therefore we must provide them with the best of weapons in order that if fight we must, we may do so at the least cost in lives.

Unfortunately, in days gone by a vigilant public opinion did not always guard this philosophy against the inroads of wishful thinking and false economy. In 1860, for example, we find the War Department—understandably disquieted at the state of the Nation—timidly asking Congress for $400,000 to buy new model percussion-cap rifles for the militia.

Request Rebuffed

This modest request was sternly rebuffed by Senator Wilson of Massachusetts. Pointing to the fact that there were 190,000 smoothbore muskets in the various arsenals, he cried:

"These arms were good enough to fight the Mexican war with; they have been good enough to fight the battles of the country in the past, and, I think, are as good to be distributed among the militia of the country, for the purpose for which the militia need to use them, as the improved arms that are now being made."

Learned by Experience

A year later this same Senator Wilson—in the new and unaccustomed quality of colonel of the 22nd Massachusetts Volunteer Infantry—was making painful first-hand acquaintance with "the purpose for which the militia need to use arms" and was having plenty to say about the negligence and lack of foresight of the War Department.

No subject, indeed, was the occasion of more scathing public and Congressional comment in the early days of the Civil War than the lack of proper weapons for the swarms of volunteer troops which were so hastily assembled. Yet these bitter memories did not produce corrective action when, a few years later, the Army pointed out that its soldiers armed with single-shot Springfields were fighting Indians provided with Winchester repeaters.

Nor did even this lesson prevent an American army from showing up before the Spanish fortifications around Santiago with volunteer regiments armed with these same smoke-belching Springfields, to fight Spaniards armed with smokeless-powder Mausers.

No Weapons System

The Spanish lesson did produce a good rifle—the Springfield '03 which remained for many years the best military rifle in the world. But it did not produce a weapons system. It took the wider and more urgent demands of World War I to do that.

The tactical need for combining riflemen and automatic weapons on the battlefield and providing infantry with high-angle weapons which could knock out hostile machine guns behind vertical cover gave us our first true infantry weapons system: the Springfield plus

Major Eliot is military and naval correspondent with General Features Syndicate and military analyst for the Mutual Broadcasting System. He is the author of several books including "The Ramparts We Watch" and "Hate, Hope, and High Explosives."

the BAR, the Browning heavy machine gun, and the 3-inch mortar. We have been developing that weapons system ever since in parallel with our armor and artillery weapons systems.

We learned as we went—as we shifted from the comforts of isolation to the burdens of world responsibility, and in the last two great wars millions of Americans gained (like Senator Wilson) first-hand acquaintance with military requirements.

We have begun seriously to turn American inventive and productive genius to the weapons problem—and the results must be viewed against the background of the past to be judged in their true perspective.

We were proud of the fact that we entered World War I with the world's best military rifle—we had little else in the weapons line to occasion pride.

In World War II we had our own weapons system, complete "from soup to nuts," and it produced among other things the best-armed infantry that fought in that great conflict. No small accomplishment for only twenty-three years of effort with precious little spending money most of the time.

There was, of course, something of a letdown after the end of the war. It would have been too much to expect that there would not be. Hopes of world peace, which proved illusory, and revulsion from the horrors of the great conflict produced their inevitable results.

The immense stocks of arms and munitions left over from the war produced as hypnotic an effect on the congressional mind of 1946 as did the 190,000 Mexican War muskets on the congressional mind of 1860.

Research Continued

Yet the letdown was far from total. There was little actual production, but research and development continued, and a few modest production programs were pushed ahead on the most urgent items.

When the Korean shock came, we were not exactly ready "to the last gaiter button," but we were able to fight, and the new types of weapons we absolutely had to have—a more powerful rocket-launcher and a better medium tank—we were able to provide within a reasonable length of time.

The Virtue of System

This is the great virtue of systematized infantry weapons development. Such a system does not seek to do everything at once. It establishes priorities in accordance with changing tactical needs. It operates by the only acceptable yardstick—comparative firepower on the battlefield. The infantry it serves must be able to produce a higher volume of firepower than any opposing infantry.

Weapons which meet this standard are retained as long as they are useful. Weapons which do not meet it, or which are outmoded by changing tactical requirements, are replaced or discarded.

Ideally—and the ideal is very nearly met in practice—there should be behind every weapon actually in the hands of troops a test model of a better weapon undergoing trials at a proving ground or in the hands of field-test teams, and behind that the blueprint of a still better one being mulled over by the research and development people.

The Time Factor

But it is well to remember the time lags in these processes. Even an approved test model may be years away from full-scale production; a blueprint much further off. Some schedules may be hastened by selective pressures or they may be retarded to give priority to more urgent items.

None of this is simple—there is just nothing simple at all about the armament business these days. A great deal of sound judgment and at times almost superhuman foresight are demanded of all concerned—at top level and all the way down the line through the Army Field Forces, the Infantry Board, the Ordnance Corps, and the civilian producers—just to mention a few of those immediately concerned.

No one will claim that the results have been perfect. But on the whole the judgment has been sound and the foresight, if not superhuman, at least reasonably acute. Thus the 3.5-inch rocket launcher, to meet the threat of improved hostile tanks, was ready when it was needed in Korea.

Who can say whether it would have been ready, if more time and money had, instead, been devoted to producing a fully automatic rifle—which is not needed yet, as the M1 plus the BAR are notably superior to anything opposed to them and fully adequate for some time yet to meet their battlefield responsibilities, which the old 2.36-inch rocket launcher definitely wasn't.

"Pick and Choose"

After all, you *can't* do everything at once. There are only so many tons of steel, so many skilled man-hours, so many dollars of appropriated funds available. You have to pick and choose.

Of the wisdom of the choices made, the battlefield is the supreme test. From its verdict there can be no appeal. It has, for example, yet to be shown that there are any unnecessary dead in Korea as a result of not having fully automatic rifles.

But very considerable numbers of American soldiers are walking around on their two feet today who would be filling graves or hospital beds if a reliable rocket launcher capable of stopping the T34 tank hadn't been ready for their use.

An effective infantry weapons system is a living organism. The fresh blood of innovation and progress must flow constantly through its veins, though it must—so to speak—avoid the high blood pressure of constant change for the sake of change.

Mere solidified resistance to anything new can, of course, kill it. The wonderfully intricate weapons system of the medieval knight perished when the feudal mind inside the visored helmet refused to accept the fact of peasant infantry armed with the longbow or the musket—and feudalism perished with it.

But the more complex the system the greater the care that must be given to changing any of the interdependent parts under the pressure of mere spe-

cialist enthusiasms. It is the system which produces firepower and mobility on the battlefield.

The final test—the final verdict—is whether the system does this better than any opposing system. And the opponents have the same headaches. Every nation with a large army has to answer the same perplexing questions of choice, design, test, production, acceptance, and interrelationship of the growing family of infantry weapons.

As to any particular weapon, its value must be considered solely on the basis of how well it plays its part in the whole system of weapons. Your gadget-minded expert will always be able to produce the most convincing technical reasons why this or that weapon is outmoded—indeed in most cases he has only to point to the newer types already under test.

Old Weapons Usable

But to discard a weapon of proven effectiveness which is still superior to anything in opposing armies involves widespread costs and dislocations which may well be unjustified. The old weapon cannot be laid aside until there are enough of the new either on hand or coming off the assembly lines to reëquip the whole army (including the civilian components).

Enough manufacturing capacity must be available so that in case of full mobilization the new weapon could be supplied in adequate quantities. The weapons system must be adjusted to receive and use it. The training system must be adapted to it. Stocks of ammunition and spare parts must be available.

So it isn't much to the point to say that such-and-such a weapon is too old, or too heavy, or doesn't shoot as far or fast as the latest razzle-dazzle hot-shot type. What is to the point is simply this: Does it do what it's supposed to do as part of our infantry weapons system? Is it an asset or a liability?

Minor defects can be cured, and should be cured, by minor changes—such as the steady reduction of weight in machine-gun tripods by the use of alloy metals. Tactical innovations—such as the Korean system of using two BAR's in each infantry squad—may bring about adjustments in the relative importance of weapons.

The ability to make changes of this sort and take them in stride are the outward and visible signs of a healthy, living, growing weapons system, steering its careful course between the Scylla of woodenheaded conservatism ("they were good enough to fight the Mexican War and they're good enough today") and the Charybdis of flutter-headed innovation for the sake of innovation, while constantly and honestly subjecting itself to the yardstick of comparison *as a system* with any possible competing system.

Army photo

A 75-mm. recoilless-rifle team prepares to fire on Communists near the Han River.

Pertinent Comments

That the United States has an infantry weapons system of this character, which is superior in firepower and battlefield mobility to anything the Communist world can throw at it, we have the best of evidence: the battlefield itself. The writer has recently come into possession of comments based on Korean experience which make this fact clear beyond reasonable dispute.

Here are a few typical comments—not all of them, as will be seen, uncritical, but adding up to just one thing: we have a better weapons system than *they* have:

The M1 rifle.—"Superior to the Russian rifle (Tokarev M1938, M1940, or M1944) in simplicity, durability, accuracy, and reliability under all combat conditions (heat, cold, mud, rain) . . . Never fails in combat."—*Rifle company commander.*

"Not automatic, of course, but I say it can fire as fast as it can be aimed, and that's what counts."—*Rifle squad leader.*

Browning automatic rifle (BAR).—"Our most mobile and accurate base of automatic small-arms fire. The most reliable light automatic weapon in the hands of any army. *No* foreign automatic rifle will even closely compare with the BAR in accuracy, reliability under various combat conditions, or freedom from mechanical malfunctions. . . Mud, rain, snow, or Commies couldn't stop 'em. The Commies don't go after our BAR's like they do the machine guns, or else they can't catch up with us. Meanwhile we're giving them the works."—*Rifle platoon sergeant.*

"My BAR's were the mainstay for my firepower in a rapidly moving attack. They were always there and working when needed."—*Rifle company commander.*

Light machine gun (M1919A6).—"More effective than the Russian Dektyarov in accuracy and volume of fire, but heavier. . . Very effective in all kinds of weather."—*Commander of ROK rifle company.*

"Where I could, I liked to replace the LMG's with heavies. They weighed a little more but were far more accurate and could keep up sustained fire at medium rate almost indefinitely."—*Another rifle company commander.*

Heavy machine gun (1917A1).—No mixed verdict here. "Most reliable and accurate heavy machine gun in the world—proved both in World War II and in Korea. . . Superior to the Russian heavy machine gun in mobility and firepower. . . The biggest headache I had was trying to keep some rifle company from stealing my heavies. Oh, yes, the watercooled gun may seem a little heavy, but it will fire almost indefinitely. It's more accurate than any other machine gun I've seen, ours or the Commies'."—*Machine-gun platoon sergeant.*

60-mm. mortar (M19).—"The Russian 50-mm. mortar is not comparable to the 60-mm. in range or effectiveness. . . Fills the bill completely on targets up to 600 yards. After that you can't tell where in the hell you'll hit. Use the 60-mm. M1 barrel with the M19 small base plate, throw away the bipod and use as a hand-held weapon, and it couldn't be beat."—*Weapons platoon sergeant.*

"For close-in work it couldn't be beat. The Commies' light mortar was pretty sad; about one out of three of their rounds were duds."—*Mortar section leader.*

81-mm. mortar (M1 and M29).—"One of our most effective weapons. The Commies' Russian 82-mm. couldn't compare in accuracy as it was made mostly of stamped parts. They couldn't fire battery fire either, and couldn't get the fragmentation we could. The new M29 is even lighter and has a circular base plate."—*Mortar platoon sergeant.*

"I've seen the 81-mm. mortar break up too many attacks to doubt its accuracy or ability to lay down the meanest type of fire. The Commies especially feared our WP shells. Their ammo wasn't bore safe and had to be fuzed after the gun was set up. That slowed them down all along the line."—*Mortar section leader.*

4.2-inch heavy mortar (M2, M30).—"Most deadly and most feared weapon in our infantry mortar family. . . Superior to the 120-mm. Russian mortar in accuracy and volume of fire; ammunition superior in fragmentation, safety in handling, and freedom from mechanical malfunctions. . . The 4.2 is our most deadly weapon. We can outfire our own 105-mm. howitzers any time. Most of our regiments want to double the number of their 4.2's. Why, if they aren't getting the best from them?"—*Heavy-mortar company commander.*

"That the United States has an infantry weapons system . . . superior in firepower and battlefield mobility to anything the Communist world can throw at it, we have the best of evidence: the battlefield itself."

57-mm. recoilless rifle (M-18).—"Most effective weapon in the rifle company—deadly against personnel or bunkers up to 1,200 yards. The weight never bothered men. They were more than willing to put them where needed—especially after seeing them in operation just once."—*Rifle company commander; 57-mm. section leader.*

75-mm. recoilless rifle (M-20).—"Accurate as a die up to 4,000 yards. More effective against bunkers and pillboxes than napalm or artillery. I believe most 57-mm. crews would like to change to 75-mm. because of its much greater range."—*75-mm. platoon leader.*

3.5-inch rocket, with M-20 or M20B1 launcher.—"The answer to a prayer—how to stop the T34's. Ability to penetrate the heaviest armor of any known tank (at fifty to seventy-five yards) is unquestioned."—*Rifle platoon leader in Korea during June-December 1950.*

Hand grenade Mark II.—"Superior in every way to the Russian hand grenade. . . Our grenades are better than anything the Commies toss at us."—*Infantry private.*

The one infantry weapon which comes in for all-round criticism is the carbine. One officer damns it with faint praise—"A fine weapon for a dustless country." Other comments:

"Sensitive to heat, cold, and dirt. The full-automatic fire feature is ineffective. . . Seems to be in high disfavor with a heavy majority of users in World War II and Korea. Most carbine carriers much prefer M1's today. . ."—*Weapons platoon sergeant.*

The only other major criticism is a composite comment about our powder: "A heavy majority of combat infantrymen of every rank wish that we had a 'real' smokeless powder for our rifles and machine guns, if not for all weapons."

So the evidence is in. Thumbs down on the carbine—an emergency weapon anyway. A somewhat circumscribed field of usefulness for the light machine gun. Eliminate flash and smoke in small-arms powder.

Superior Weapons System

But, beyond all question, we do have an infantry weapons system which in all its essential parts is definitely superior to the enemy's weapons system. We have a better rifle, a better automatic rifle, a better heavy machine gun, better mortars, and better grenades. And we're improving as we go. When we needed a better rocket launcher, we got one. We're making our machine-gun tripods and mortar base plates lighter. Other new weapons are coming along—we'll be ready to replace older types when necessity appears.

We have and will continue to have the best armed infantry in the world. I don't ask you to take my word for it. The battlefield gives the verdict.

Independent Research

Private Institutes Aid Both Industry and Defense

by

Dr. Clyde Williams

Director, Battelle Memorial Institute

The research foundation is unique to the United States and is an outgrowth of the American enterprise system

THE terms "independent research institute" or "independent research foundation" generally refer to organizations that conduct research for industry and government on a nonprofit basis. These organizations are usually endowed, have philanthropic or educational motives, and are independent of both industrial corporations and the Federal Government. Some have ties with universities, and in that sense may not be completely independent of a parent organization.

Certain research foundations associated closely with universities function similarly to the independent research institutes, and many of the observations made here will likewise apply to these organizations.

Founded or Endowed

The research institute is unique to the United States and is an outgrowth of the American enterprise system. The major organizations in this group were founded or endowed by persons of wealth who saw a need for well-equipped research centers to serve industry and who regarded the endowing of such institutions as a means of performing a lasting public service.

The oldest is the Mellon Institute for Industrial Research, Pittsburgh, founded in 1913. Franklin Institute, Philadelphia, established in 1824, began operating as an industrial research institute in 1925. Battelle Memorial Institute, Columbus, was founded in 1929, and the Armour Research Foundation, Chicago, in 1936.

Others include the Midwest Research Institute in Kansas City; the Southwest Research Institute in San Antonio; the Southern Research Institute in Birmingham; the Stanford Research Institute in Palo Alto, Calif.; and the Texas Research Foundation near Dallas.

Many university research foundations function similarly to the independent research institutes. Among them are the Alfred University Research Foundation, Case Institute of Technology, the Colorado School of Mines Research Foundation, the Institute of Industrial Research of the University of Denver, the Industrial Science Research Institute of Iowa State College, the Institute for Coöperative Research of Johns Hopkins University, the University of Kansas Research Foundation, the University of Louisville Institute of Industrial Research, the Division of Industrial Cooperation of the Massachusetts Institute of Technology, the Engineering Research Institute of the University of Michigan, the Ohio State University Research Foundation, the Purdue Research Foundation, the Engineering Experiment Station and the Department of Mining and Metallurgical Research of the University of Utah, Wayne Engineering Research Institute, and others.

These university research foundations, together with independent research institutes, handled $297 million in research contracts for Federal agencies in the fiscal year 1951, and $341 million in the fiscal year 1952, according to a recent report made by the National Science Foundation.

Services Rendered

These research institutes and foundations render a public service through publications, the conduct of fundamental research, dissemination of scientific and engineering information, and in many other ways. The Arthur D. Little Company, although a privately owned corporation, provides extraordinary public service and functions quite similarly to the research institutes and foundations.

The independent research institutes alone conduct an appreciable share of the country's research business. The National Academy of Sciences of the National Research Council in a report entitled, "Applied Research in the United States," dated March 1, 1952, estimates the volume of research for industry and government being handled by the independent research institutes at $35 to $40 million annually.

Growth in the volume of research since the report was compiled would probably push the figure over the $50-million mark. Estimates of 1952 research expenditures for the four largest research institutes—Battelle, Armour, Stanford, and Mellon—made in late 1952 showed that these four alone would do $29 to $30 million worth of business.

Good Proportion

Although the amount of research conducted by the research institutes is less than 2 per cent of the total national research effort of $2.75 to $3 billion, it represents a sizable propor-

tion for less than a dozen laboratories. The other 98 per cent of the research total is handled by some 3,300 industrial laboratories, several hundred universities, and by the laboratories of the various governmental agencies.

In addition to sharing a significant part of the total research effort, the research institutes serve a wide segment of American industry. While one industrial laboratory usually serves but one company, the individual institute conducts research for numerous companies. Battelle, for instance, has served nearly one thousand individual companies and governmental agencies since its founding in 1929. Research institutes thus exert an influence on technology far out of proportion to their numerical strength or to the volume of business conducted.

The research institutes have several special functions that make them of great benefit to the national economy. Probably the most important of these is their making available to all industry—including even the smallest companies—a rounded research organization.

Technology is so complicated today that the simplest technical problems of industry may require vast investments in research equipment, organization, and technical manpower for their solution. Obviously, many companies do not have the financial resources needed to equip and staff a laboratory adequate to do effective research. But by taking their problems to a research institute, they can obtain, at cost, the advantages of a large, well-equipped and well-staffed laboratory.

Benefits Large

As the *Wall Street Journal* recently stated in commenting upon Battelle's services to industrial companies: "They (the companies) get just about the same benefits and services as if they owned the $15-million lab."

Thus the research institute makes possible private research that otherwise would be impossible. As a result, companies that could not afford even modest research laboratories carry on regular programs of research at research institutes. This enables them to solve production problems, develop new products, and to expand. Competition is increased, with all its benefits to the economy.

Progress Stimulated

The work conducted by the research institutes for large companies also stimulates national progress. By using research institutes to supplement the work of their own laboratories, large corporations get new ideas and fresh approaches to their problems.

Large companies also find research institutes particularly useful when they wish to expand temporarily their research activities beyond normal laboratory capacity or when they wish to conduct studies requiring equipment and personnel for which they would have only limited use.

In effect, then, the research institutes are additional wings to corporation laboratories. They are already capitalized and functioning for use whenever the occasion demands or is opportune.

Ideas Exchanged

Still another influence on technology exerted by the research institutes is one that is not so readily apparent. These organizations, as sites of research for diverse industries, are meeting grounds for the exchange of ideas between diverse technologies. New techniques developed in one field of technology can be applied immediately in other fields where the relation may seem extremely remote.

For instance, at Battelle a few years ago we developed information in the field of electrical engineering that was immediately usable in our studies of plant diseases. Another time, work on the processing of fine coal led to techniques which could be used for drying grain. One of the major steps in the development of xerography, an electrostatic process for image and copy reproduction, took place when our graphic-arts technologists borrowed a process from our nonferrous metallurgists.

In industrial laboratories, where the field of interest and activity is fairly well circumscribed, months or even years may lapse before new ideas from one technology filter through the literature to other technologies. In rounding up and herding together many technologies, the research institutes greatly accelerate the processes of communication between sciences and thus hasten industrial progress.

Perhaps one of the most important contributions the research institutes have made to technology—and thus to the national economy—has been the demonstration of teamwork in getting research results. Having upon their staffs diversified talent in many sciences, the research institutes have developed methods of coördinating and using these talents effectively.

Effectiveness Proved

Long before the Manhattan Project was set up as the first huge experiment in coöperative research, the research institutes and the larger industrial laboratories had adequately proved the effectiveness of group-coöperation procedures.

Teamwork among scientists is used almost universally today; practically all industrial research within this country is attacked by teams of specialists. When the older research institutes entered the field, however, much research was still largely a matter of lone-wolf experimentation and cut-and-try procedure. In these institutes the type of coöperation used by the Manhattan Project reached a high form of development in the 1930's.

Obviously, the development of independent research institutions within this country has been fortunate from the standpoint of national defense. By stimulating and expanding industrial research, increasing competition, and accelerating the progress of technology, the research institutes have made the country stronger industrially and militarily. These organizations also have provided on-the-spot functioning facilities for the execution of military research.

Today, somewhat more than half the research being conducted by research institutes is for the Army, Navy, Air Force, Atomic Energy Commis-

sion, and other instruments for national defense. At Battelle the current research is almost evenly fifty per cent Government, fifty per cent industrial. Armour is reported to be devoting about two-thirds of its effort to national defense, and Stanford, fifty per cent.

Additional Reasons

Aside from the fact that research institutes are available to get the military research job done when it is needed, there are other reasons why their existence is fortunate from the standpoint of national defense. They make for efficiency, higher productivity, and economy in military research. They save the taxpayers' dollars.

If the Government had to build and equip laboratories to handle this additional military research, many millions of dollars of taxpayers' money would be required for their construction and maintenance.

If kept up during peace, the maintenance costs would be a constant burden to our people. If abandoned during peace and rebuilt as needed, possibly even greater expenditures would be involved. As it is, the taxpayers are relieved of capital expenses and pay only negligible maintenance and capital depreciation costs incurred during the periods of actual research.

Other Benefits

Governmental agencies, of course, derive other economic benefits by their use of research institutes. Since these research organizations have continuing functions, they are able to amass the highest type of personnel.

If the Government hurriedly had to assemble scientific personnel to conduct special research jobs, it could select only from the limited number of people immediately available. In the welding together of working organizations, time and considerable money would be lost. Even after a special research organization had been formed, it would be difficult to match the efficiency of established research teams within research institutes.

In the execution of governmental research, the nonprofit institutes save the taxpayers' money.

Still other advantages to national defense result from the nature of the research institutes. When a research project is placed with these laboratories, the work to be done is specified in a contract. There is a fixed time limit that must be met. This assures getting the job done in time to be useful to the military effort.

Duplication of research is also avoided by the use of research institutes. As centers of widespread research efforts, the independent organizations have better chance of knowing what is going on from laboratory group to laboratory group. Sometimes a phase of a problem being studied, say, for the Navy, will be directly applicable to a phase of a different problem being studied for the Air Force.

The men who direct and supervise research within the institutes spot duplications before they occur and save the taxpayers unnecessary expense. All the research institutes, by the very nature of their business, must be alert to the duplication of research at all times. They have well-established mechanisms for preventing wasted effort.

Technology tends to inbreed and grow sterile if too closely confined. This is recognized by big corporations who use research institutes for bringing new ideas and approaches to their research. The same applies to government. The letting of military research contracts to outside laboratories is one of the best ways to prevent inbreeding of military technology.

In the matter of transference of research information to the ultimate user, the research institute setup is particularly advantageous. The technical personnel in research institutes know and are accustomed to working with technical and production men in manufacturing plants.

Effects of Close Liaison

Close liaison between those who gather data for the Government and those who use the Government's data makes for quicker application and better understanding of technical information.

The acceptance of research institutes by industry and government is one of the best ways of measuring their rôle in the national economy. There can be no doubt about their acceptance; it is something that can be demonstrated graphically.

Institutes Growing

Research institutes are growing at an exponential rate and they are growing faster than research nationally. In fact, in the past eleven years Battelle's research has increased more than 1,700 per cent while total U. S. research has increased about 360 per cent.

Looking to the future, we may expect to see research institutes play increasingly important rôles in national and international affairs. With the entire U. S. economy drawing its strength from the laboratory—using research to solve problems, heighten competition, and create opportunities for capital expansion—only a great catastrophe could reverse present trends.

The continued expansion of the facilities of present research institutes will be needed to meet the demand. It is also very likely that new organizations, patterned after the established institutes, will arise.

Armour, Stanford, Battelle, and possibly some of the other institutes are also looking to foreign soils for expansion of their services. Battelle has a new $1.5 million laboratory center now under construction in Frankfurt am Main, Germany. Another Battelle research center has been established in Geneva, Switzerland, and still others are planned for France, Italy, and possibly England.

Europe Can Benefit

It is Battelle's belief that the economies of Europe can be benefited by the research institute plan just as the American economy has been benefited.

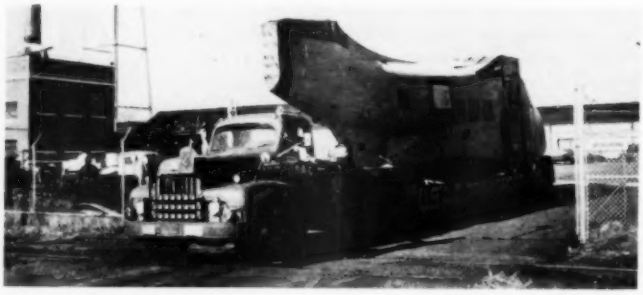
Perhaps the idea of providing centralized facilities where industry can work out its technical problems will become a significant factor in raising world living standards and preventing friction between the world's people.

If so, the day may come when these great laboratories will be able to devote one hundred per cent of their efforts to the development of the products of peace.

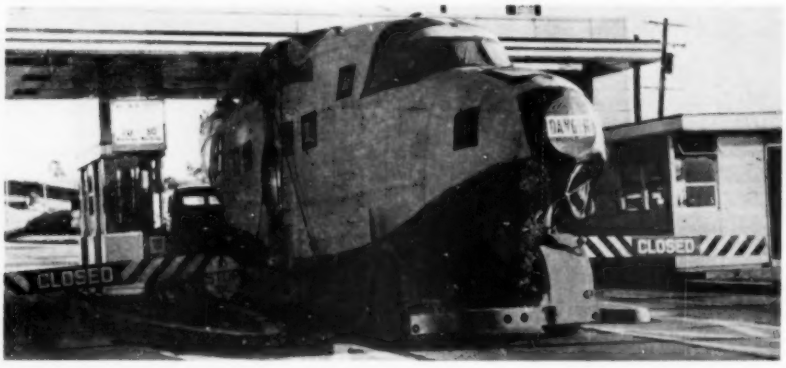
Cross-Country Flying Boat

Completed Albatross, above, on Coast Guard patrol duty in Great Lakes region.

Coöperation between Chrysler Corporation and Grumman Aircraft is producing the "Albatross" amphibian on a 984-mile "assembly line." Chrysler-built hulls are carried overland from Evansville, Ind., for completion at the big Grumman aircraft plant in Bethpage, L. I.

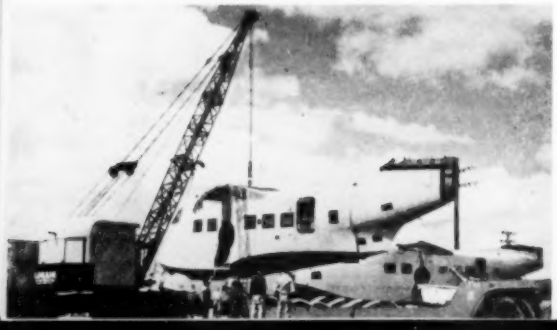


First completed hull, above, begins cross-country trip from Evansville to Bethpage.



Left, entering the Pennsylvania turnpike, the Chrysler-built hull of a new air-rescue plane just manages to edge under the 13-foot tunnel clearance marker at the Irwin tollgate.

Below, hull arrives at end of assembly line, Bethpage, L. I.



Completed by Grumman, the ship is ready for its test flight.

The Air Force and Guided Missiles

New Weapons Will Be Used To Meet the Demands of Combat

by

Brig. Gen. E. P. Mechling

"Pilotless aircraft represent a normal extension of the aircraft the Air Force has been developing for years."

THE idea of guided missiles within the United States Air Force is nothing new. We call them "pilotless aircraft" and "guided aircraft rockets." The Air Force was created to conduct combat operations under the general classification of air warfare. The Air Force will continue to carry out its responsibilities for air warfare as directed, whether or not men are required to ride in our aircraft.

Decision Made

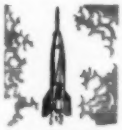
I mention this basic concept because it affects the way we handle this problem throughout our structure. If you will look through our major organization and function charts at all levels, you will find essentially no reference by name to major staff agencies concerned solely with guided missiles. The decision was made shortly after the war to handle the missile problem through the same offices and in the same manner as we handle other aircraft weapons systems.

To cover this in some detail, the long-range studies of the War Plans Division, under the Deputy Chief of Staff, Operations, anticipated the need for aircraft weapons systems of superior effectiveness to meet the more difficult problems of future war efforts. Without undue formality these concepts are made available to the Air Staff, and particularly to the Director of Requirements, under the Deputy Chief of Staff, Development.

Procedure

Again there is no separate requirements agency for considering missiles. One of the divisions—Air Defense, Tactical, or Strategic—of the Directorate of Requirements will pick up the problem, thoroughly analyze it, and establish, if warranted, a general operational requirement. This, in turn, is passed to the Director of Research and Development under the Deputy for Development, and here the matter receives further study and coördination and is then passed to the Commanding General of the Air Research and Development Command for development action.

The pattern in the Research and Development Command Headquarters is similar in that there is no specialized agency for handling missile problems. The responsibility for undertaking development in the field of missiles rests, as for aircraft, with the Wright Air Development Center.



Within this organization there is an office known as the Guided Missiles Laboratory charged with the technical administration of missile development contracts. Our development of missiles is not undertaken within Air Force-operated establishments.

General Mechling is commanding general of the Air Armament Center, Air Research and Development Command, Eglin Air Force Base, Fla.

This is an address delivered by General Mechling at the first Southwest Regional Meeting of the American Ordnance Association held at El Paso, Tex., November 6 and 7, 1952.

The entire development process is contracted by leading industrial firms, particularly those of the aircraft industry. The process so far outlined will result in equipment to test. It is when we get to this point that we achieve some true specialization in the missile field.

You are all well aware of our Long-Range Missile Proving Ground, now known as the Air Force Missile Test Center at Patrick Air Force Base. This major installation is charged with providing range and related test facilities for missiles of all ranges.

Test Firings

At this establishment we conduct our engineering test firings, our operational suitability test firings, and also, for some years to come, firings required in the training of our early guided-missile units.

This heavy load has pointed up the prime necessity of making full use of the capability of our Holloman location, now designated the Holloman Air Development Center. The statement of the functions and mission of this newly constituted center will provide very valuable support for development testing, particularly in the early phases, for our major missile contractors.

The Air Force Armament Center does not have major or direct responsibility for missile development or testing; however, the two fields are related and, to some degree, the center will be involved in testing common or similar components during development stages.

Evolution of Weapons

The Air Force is particularly interested in the natural evolution of air weapons now crystallizing into specific applications of guided missiles as complementary to manned aircraft. The increasingly important rôles of air power foreshadow volume use of these

developments in air defensive-offensive operations.

The economy of lives of aircraft crewmen and of material, together with their inherent effectiveness against the enemy, dictates that guided missiles be considered as having great potential and usefulness in accomplishing the assigned and intrinsic rôles and missions of the Air Force.

Types of Missiles

There are many types of guided missiles. Prominent in this family are pilotless aircraft and guided aircraft rockets. A pilotless aircraft is an airplane which is equipped to function without a human pilot aboard.

This unmanned airborne vehicle is designed to perform one or more of the operational functions of the Air Force—such as air offense, air defense, reconnaissance, and escort—and whose flight path is controlled after take-off by an autopilot-navigator.

Among the pilotless aircraft used in the conduct of these air operations will be included some large guided rockets; that is, aircraft using rocket propulsion. A guided aircraft rocket is a type of self-propelled aircraft armament normally carried by piloted aircraft and which, after launching, can be guided by various means to the target which it destroys by means of an explosive warhead.

The success with which the Air Force continues to perform its assigned rôles and missions will be dependent in a large measure upon the development of pilotless aircraft and guided aircraft rockets to supplement or replace existing types of equipment. For this reason the Air Force will vigorously continue efforts to enhance its combat capability through the development of pilotless aircraft and guided aircraft rockets.

This effort will be carried on, as it has been in the past, as a part of an Air Force Research and Development Program aimed toward incorporating into Air Force weapons systems all the advantages provided by scientific and technical progress.

The Air Force has always maintained a broad program to develop all types of aircraft and aircraft armament that are needed to meet its military requirements. Technical advances achieved over the years by this program have tended toward making flight more and more automatic.

Automatic pilots, automatic bombing systems, automatically fired and sighted guns and rockets, and other related developments have been combined to reduce the number of crew members necessary for certain types of aircraft. The newest link in the chain of this evolutionary process are pilotless aircraft and guided aircraft rockets.

Major Contributions

Pointing the way toward the attainment of present-day achievements were many Air Force developments beginning shortly after World War I with the Kettering-Sperry pilotless aircraft project and continuing at Wright Field during the 'twenties and 'thirties with the development of a wide variety of automatic-flight components. This sustained research and development effort made major contributions to the achievement of flight instruments and automatic mechanisms that made all-weather flying a reality.

In developing automatic gyropilots and bombing devices together with a wide variety of aircraft radar installations, "mechanical-brain" computers, and aircraft armament systems, Air Force research and development made possible the experimental introduction of a number of embryo versions in World War II. These World War II types included the Tarzon, Felix, GB-4, and Tiamat missiles, as well as the explosives-laden B-17 drones. They were controlled by radio, television, or preset gyro devices and enjoyed a limited success.

Since World War II, the Air Force has continued its program for the development of pilotless aircraft and guided aircraft rockets as intensively as the funds made available for that purpose would permit.

Normal Refinement

Pilotless aircraft, therefore, represent a normal extension and a refinement of the aircraft the Air Force has been developing for years. In the same sense, the transition of Air Force air-offense, air-defense, reconnaissance, or other types of organizations from piloted to pilotless aircraft will be a continuation of the process that, through the years, has supplanted obsolescent aircraft with up-to-date models and has been responsible for the ever-growing effectiveness of Air Force units in meeting the problems of defense.

The fact that the transition from piloted to pilotless aircraft will indeed be a smooth and unimpeded continuation of this process is borne out by the experience of the Air Force with pilotless aircraft since the end of World War II.

Existing Air Force organizations and procedures have been found adaptable to the requirements for developing, testing, procuring, and operating pilotless aircraft, and for training the officers and airmen who will handle them. Concepts concerning the organization of pilotless aircraft units, their logistic support, and their tactical operation are being developed that basically adhere to existing concepts for Air Force operations.

Minor Readjustment

In short, it has become clear that the Air Force will incorporate pilotless aircraft into its organization with only slightly more readjustment than is necessary when new models of more conventional aircraft types are made available to its flying units.

The Air Force will complement or replace its existing aircraft and aircraft armament with pilotless aircraft and guided aircraft rockets wherever combat effectiveness will be increased thereby. This process will be carried out as rapidly as technical and operational experience is gained sufficient to warrant such substitution.

Whether or not pilotless aircraft eventually will perform a major portion of the combat functions of the Air Force remains to be seen, but certainly piloted as well as pilotless aircraft will be developed and procured for many years.

U. S. Army photo

Armament Progress

Industry-Ordnance Team Creates Better Mobilization Production

Maj. Gen. E. L. Cummings

Chief, Industrial Division, Office, Chief of Ordnance, U. S. Army

THIS past year has been one of greater Ordnance accomplishment than we have seen in any comparable period since World War II. And in speaking primarily of these accomplishments, I do not mean to imply that all our former problems have been solved. We still have many of those, with a few new ones added.

Ordnance Objectives

Our Army Ordnance objectives, as stated in broad terms a year ago, remain pretty much the same today. These are:

1. To produce and procure new Ordnance matériel for the expanded Army, Navy, and Air Force—and, to some extent, for our allies overseas.

2. To reconstitute our worldwide reserve stocks in storage and in the hands of troops.

3. To continue and increase our progressive research and development program.

4. To establish and maintain industry on a production base broad enough so it will be in a position to expand rapidly to meet our needs if all-out mobilization becomes necessary.

Operations Vary

The nature and character of our operations in striving to attain these objectives vary with each new phase, but primarily our objectives are still the same.

In so far as procurement is concerned, we devoted particular attention to placing orders wisely and to getting them placed as early as possible. With orders for the year amounting to a total of nearly $12 billion, this has been a big job. But it is always essential that we get contracts placed early so that contractors will have ample time to prepare production schedules and avoid production gaps. Any delays in placing contracts inevitably delay production.

The intelligent placing of orders is very important, but figures concerning items "on order" are a poor measure of actual progress and accomplishment. The real measure of accomplishment is shown in the figures on deliveries. They represent the "pay-off." So let's look at some delivery figures.

Four Billion Dollars

I am pleased to be able to report that, dollar-wise, total Ordnance deliveries for the fiscal year 1952 were more than four times as large as those for fiscal year 1951. In the latter year, deliveries amounted to approximately $900 million; in fiscal year 1952 they amounted to $4 billion.

These figures present a good picture of the progress of the Ordnance procurement program. This is one kind of report I'm sure all of you have been wanting to hear. Certainly it is the kind of report we have been looking forward to giving.

This does not mean that we are entirely satisfied with our progress by any means. We have had our setbacks here and there in the past, and we probably will have others from time to time. It does mean, however, that new ordnance matériel is now rolling off production lines in significant and ever-increasing quantities.

In our present situation we find ourselves in the zone where the long production lead times needed to produce many major items of ordnance are expiring. The necessity for long production lead time in ordnance manufacture is something that never seems to be understood completely.

It takes a long time, for example, to build a new combat vehicle. To do the best job we ought to have eighteen months at least for the research and development phase of it alone and an equal amount of time for the production phase—a total of three years for the entire project. Even more time is needed if new types of weapons and fire-control equipment are to be included.

The "Atomic Gun"

Take the case of the 280-mm. gun, popularly referred to as our atomic artillery weapon, which was officially

unveiled in October at Aberdeen Proving Ground.

The design of a heavy field-artillery piece which would overcome certain deficiencies encountered in World War II weapons was initiated by the Chief of Ordnance in November 1944. Manufacture of the first pilot model was not begun until 1948; then the new requirement developed for an artillery piece that would accommodate an atomic charge.

Fortunately, our research and development work had been sufficiently progressive and forward-looking so that when appropriate design changes to meet this new requirement were ordered in November 1949 these changes could be made in a comparatively short time and without too much additional study.

At any rate, the first complete assembly with atomic-firing capabilities was not ready for testing until the spring of 1951—about 6½ years after the design project for a new heavy field-artillery weapon was initiated.

And as for the production phase, the most successful of our prime contractors on the gun carriage received a letter order for an undisclosed number of these in February 1951. On July 18, 1952—approximately seventeen months later—the first carriage was completed.

Lead Times Expiring

But, despite the need for long lead times, as I have already said, we are now in the time zone where the production lead times are expiring for many items.

Ordnance deliveries reached a rate of approximately $550 million last May. This was followed by a downward trend in succeeding months because of the nationwide steel strike which lasted six weeks. However the program recovered sufficiently after the strike was settled to reach a new delivery peak of over $600 million during October, despite the shortage of steel and the continuing wage-labor disputes throughout the country, especially at plants producing automotive items.

I have been discussing procurement and deliveries in terms of dollars, as the dollar is a measure of comparison which is readily understood. But let us take a look at some of the specific items involved.

First, there is our new family of tanks—light, medium, and heavy. The T41 light-gun tank, the "Walker Bulldog," was the first completely new tank built by the Army since World War II. In the medium tank field, we were able to present two new tanks during the past year—the M47 in April and the Patton 48 in July.

And as for heavy tanks, while we have not yet publicly unveiled it, I am able to tell you that we have one for which a quantity production order was placed some time ago. This has been designated the T43.

New Personnel Carrier

In addition to tanks, initial deliveries of the new armored personnel carrier, the T18E1, have been made to the using services during this past year. This vehicle is designed for carrying infantry troops into battle right along with the tanks. It can go anywhere a tank can go and furnishes a high degree of armored protection to personnel.

As you probably are well aware, our tank-automotive program, dollarwise, is our biggest job. Ordnance contracts placed last year for tank and automotive matériel amounted to approximately $6 billion.

As for production, Ordnance contractors delivered approximately 217,000 wheeled vehicles in the past year and, together with the Detroit Arsenal, produced 7,000 tracked vehicles.

The urgency of the situation existing at the time of the outbreak in Korea dictated the placement of the tank and combat-vehicle program on a "crash basis" and the release for production of a whole new fleet of tank and combat vehicles ahead of schedule.

To cut down on the usual lead time it was necessary to release these vehicles before designs were frozen and, in many cases, before service test models had been built and tested.

The only alternative to this "crash program" was to go into production of World War II equipment which would require the expenditure of great sums of money to retool for these vehicles, and yet this would *not* have provided us with equipment sufficiently modern to meet the standards required for armored warfare today.

Program Paying Off

Despite all the headaches our "crash program" caused us, it is paying off in quantities of new matériel of the latest design—and we are getting it ahead of the time it normally could be expected.

The over-all production policy of the Department of Defense has been to place principal reliance for industrial preparedness on production lines in being. We have wanted to avoid accumulations of completed equipment once the initial demands of Korea have been met.

A year ago our tank and truck production lines had not yet been firmly established, production schedules had not yet been met, and it was uncertain that real production was about to be attained.

The Department of Defense feels now, however, that tank production and production of our 2½-ton truck has been sufficiently established so that a cutback can be safely made. Accordingly, one was recently announced for these programs. This will involve a gradual phasing out of certain schedules during the coming year.

This decision to cut back was not based on any change in the international situation. Should a change in this situation occur, the existence of production lines of these items operating at minimum sustaining rates will substantially reduce the time required to meet any new demands.

I have been speaking of deliveries of tanks and automotive equipment. But what about other ordnance matériel?

I have already mentioned the 280-mm. gun, though I might add that the first of these has been put into the hands of troops for training.

Then there is the new Skysweeper antiaircraft gun, which has been de-

veloped to cope with planes flying at medium altitudes. It has an electronically operated fire-control system which automatically directs the gun by radar onto moving aërial targets. No such fire-control system as this was available to troops in World War II. The Skysweeper guns are now being delivered to the using services.

Guided Missiles

For fast-flying planes at high altitudes, and for other purposes, we have guided missiles. Two of these are in production. For many years, we in Ordnance have had to speak of guided missiles in terms of the future. Now some of these are a reality. Tests on production models of our guided missile called "Nike" have justified organization of antiaircraft battalions to employ them. Tactical and technical training of officers and men is being conducted at the Guided Missile Center, Fort Bliss, Tex., and at the Ordnance White Sands Proving Ground, N. Mex.

The question is often asked as to whether our troops in Korea are receiving any of our latest equipment. The answer is, "Yes, they are receiving new equipment according to the established need as soon as it becomes available."

In so far as our tanks and combat vehicles are concerned, we had much matériel left over from World War II. This is good equipment and, where overhaul was needed, it has been rebuilt and restored to a condition "as good as new."

And as long as it is fulfilling the requirements of the battlefield, there is serious question as to the advisability of replacing this good equipment with other equipment simply because it is newer.

We must do everything we can to conserve our resources and get the most out of every bit of matériel we build or possess. However, there has never been any thought or hesitation about the issuance of the newest and latest items to front-line troops if they can give them a needed advantage.

Of all our production programs none has been more important nor received closer attention than our ammunition program. In the type of warfare we have encountered in Korea where "human-sea" tactics are employed by the enemy there has been a tremendous increase in the rates of ammunition expenditure over World War II.

A recent report of allied gunners firing nearly one thousand rounds of artillery ammunition an hour at a Communist stronghold on the Central Korean front is an indication.

According to our best estimates, the Army expended about the same number of rounds of basic artillery and mortar ammunition during the first two years of the Korean conflict as was expended in the entire European Theater in the eleven months from D-Day to VE-Day.

"Not only have we been trying to restore a reasonable defensive strength as insurance and as a possible deterrent against war, but we have also been trying to provide a mobilization base which can be expanded rapidly in case of all-out need."

As another example, expenditures of caliber .50 aircraft ammunition during the first two years of Korea have been one-third of the total Air Force caliber .50 expenditures during all of World War II in all theaters.

While we are beginning to think of a "stretch out" in production of some items of ordnance, no such slowdown is being considered in our ammunition program. On the contrary, we are exerting every effort to increase production on certain critical rounds.

Ammunition Program

The rate of expenditure of certain artillery types has made it imperative that our ammunition program be expanded if we are to insure that all future demands can be met.

This is indeed an "ammunition war," and the Birmingham Ordnance District is primarily an area of ammunition component contractors, just as it was in World War II. In this area there are fuze manufacturers, manufacturers of boosters—which are closely akin to fuzes, and shell producers. No shell producers in the country have a better record than these companies with fine organizations that know shell manufacture and take great pride in the record they have made.

With new production techniques and specially designed machines, important strides have been made in work simplification and in increasing output capabilities in certain operations since World War II. This is particularly true of ammunition production.

Let us now consider for a moment the subject of industrial mobilization planning. Because of the effect on our national economy of the tremendous ordnance procurement programs, involving, as they do, many billions of dollars, it is of the utmost importance that we so plan our production that we conserve our resources and establish a position whereby we can deliver the kind of ordnance matériel that is needed—at the right time, at the right place, and in the right quantities.

We can no more afford "too much and too soon" than we can afford "too little and too late."

Like Locomotive

This problem has received our closest attention from the very beginning—when the necessity for remobilization first became apparent. Production for defense is something like starting up a big steam locomotive. You can't get it rolling on a moment's notice if you happen to have let the fire go out or die down too far. Neither can you stop it suddenly once you've picked up speed and attained a certain momentum.

Heretofore this country has had only two throttle settings for defense mobilization—either wide open or almost completely shut off. But during the past three years our position has been different in that we have not only had to get the production engine going again but have had to determine and maintain what may be described as a safe "cruising speed."

Not only have we been trying to

restore a reasonable defensive strength as insurance and as a possible deterrent against war, but we have also been trying to provide a mobilization base which can be expanded rapidly in case of all-out need.

Attainment of such a goal has complicated our operations in Ordnance considerably. In trying to spend wisely and produce efficiently we have done a lot of things all at once.

We have increased our production capacity through the reactivation of plants which we had fortunately kept in stand-by.

New Capacity Established

We have established new capacity through production contracts strategically placed throughout industry so that production could be assured—yet at the same time avoid undue dislocation.

We have parceled out such of those highly specialized machine tools as we had kept in reserve in a way that production delays and bottlenecks would be kept to a minimum.

We have bought machine tools of all types, including some new types which it was necessary to design and build. This goes for production machinery of all kinds.

In addition, we have recruited and trained or retrained large numbers of personnel to handle the enormous increase in workload.

While all of this was going on, we gave special attention to an accelerated research and development program and to our program for rebuild.

We gave more than the usual attention to such programs as manpower utilization, work simplification, and personnel training in order to establish efficiency and to avoid as much as possible any unnecessary waste.

Cost-Consciousness

In connection with personnel training we have made a special effort to get at the problem of waste elimination through a "cost-consciousness" program for both military and civilian personnel. In this we have tried to develop an awareness in each individual for the need of securing the maximum value out of every military dollar and the need for each individual to think about his job in terms of how it can be done better, quicker, and at less cost.

We have tried to do all these things at once, and, needless to say, this has been an incredible job in its magnitude and complexity.

Think of the "headaches" of the procurement officer whose operations must conform with policies taking into account the many economic, geographic, social, and military implications in procurement!

He must consider the problem of dispersion of contracts and avoid concentration in a single large plant.

He must favor small business where possible. We like to favor small business whenever possible because we know that small businesses represent the foundation stones of our whole industrial structure. Without small business actively working with us we would not have or be able to establish a solid production base sufficiently broad to meet the requirements of a national emergency.

In addition, the procurement officer must try to place contracts in distressed areas where there is a surplus of labor and also favor distressed industries in a nondistressed area.

Emphatic Consideration

All these problems are not only factors in the industrial mobilization planning and operations of the past, but they are also factors which need to be given emphatic consideration in our plans for the future.

Since there is no way of accurately determining what the future may hold —whether we're eventually going to have to step up production or whether we can soon expect to start slowing down—there is absolute necessity for renewed emphasis at this time on our industrial mobilization planning.

It is important to do this now while we still have the valuable experience of the past three years to guide us.

We all know that a tapering off will come sometime, and Ordnance has taken steps to prepare for the eventuality that production may taper off by planning for preservation of integrated production lines and a supporting general equipment reserve.

There has been renewed interest in Washington recently in "shadow" plants which might be erected and equipped to fill gaps in the industrial-mobilization base. These would be equipped with machinery bought and owned by the Government and leased to the plant owners, to be held in stand-by for use in all-out war.

Plans Unsuccessful

Similar plans after World Wars I and II were not very well received and the efforts were not too successful.

However, we cannot afford to dissipate the sinews of our ordnance production strength again as was done after both of those wars.

We have a plan for an orderly layaway or moth-balling of production equipment as capacity becomes idle. Every effort will be made to retain equipment in place where this can be done at a reasonable cost. Otherwise, the Army-furnished and Army-owned tools will be withdrawn and so stored in Army warehouses that they can be quickly reinstalled.

I believe active pursuit of this plan, with the coöperation of industry, will insure not only an orderly layaway program but, even more important, a maximum availability of capacity required for mobilization production.

Right now, also, we must ask industry voluntarily to assist Ordnance in planning our mobilization production schedules. Experience gained up to now in our procurement program has highlighted our mobilization deficiencies by pointing up the production bottlenecks, inadequate subcontractor capacity, and the criticality of certain metals.

Industry-Ordnance Team

The Industry-Ordnance Team is an unbeatable combination when it comes to producing the goods. We've had a good year this past year—thanks to the coöperation received from industry.

EDITOR'S NOTE.—This is an address delivered by General Cummings before a meeting of the Birmingham Post of the American Ordnance Association at Birmingham, Ala., December 12, 1952.

The Gun That Won the West

A Review of H. A. Williamson's Book on the Winchester

Col. Calvin Goddard

FROM the message on the jacket of this sizable (8½- x 11-inch) volume we learn that just because he has held a chair in economics and is versed in researching the histories of great coporations, the author must not be considered as of the "professorial" type.

Not a Gun Bug

By implication we are invited to accept him as one of the fraternity—a gun enthusiast who loves nothing better than cracker-barrel discussions on arms and ammunition with others of that close-knit company. All indications are, however, that despite the jacket story, the leopard has not changed his spots.

In short, the work is characteristically that of an economist and bears none of the earmarks of the product of a genuine gun bug. It does reveal, however, an honest if not overly successful effort to satisfy the requirements of that superexacting animal. ("Winchester—The Gun That Won the West." By Harold F. Williamson. Washington: Combat Forces Press. 494 pp. $10.)

A Grand Job

But for the man in the street, Dr. Williamson has done a grand job. He has uncovered more little-known material bearing upon the Winchester saga than would seem possible. His research has evidently been meticulous and exhaustive. As a result, he has come up with an aggregation of facts and figures which, to me at least, proved fascinating. For example, though I knew that the Federal Government bought Henry rifles during the Civil War, I don't recall ever seeing in print a figure for the total. Williamson supplies it; *viz.*, 1,731.

He also prints the classical story of how, in 1863, Capt. J. M. Wilson of Kentucky, facing with empty hands seven armed guerrillas who had invaded his home to kill him as he sat at table, miraculously escaped their fire, reached a log crib across the road from his front door, secured his Henry rifle and killed all seven with eight shots. No history of Winchester (of which the Henry was the immediate ancestor) would be complete without this account, and I experience a fresh thrill each time I read it.

But new to me was a somewhat similar story of how, in 1865, two frontiersmen had been encircled by some forty Blackfoot Indians. Assuming their prospective victims to be armed with the conventional single-shot muzzle-loader of the period, the Redskins had moved in for the kill as soon as each of the white men had fired once.

"Spirit Guns"

Whereupon the palefaces *really* got down to work. Starting with full magazines (holding sixteen rounds each) they so decimated the savages that few managed to escape. Thereafter the two lucky whites were known as possessing "spirit guns," and no Indian would willingly ride within miles of their cabin.

Colonel Goddard, now serving with the Medical Corps in Washington, D.C., is a recognized authority on small arms and ammunition and a ballistic expert of world renown. He has been a contributor for many years to the pages of ORDNANCE magazine. His reprinted series of articles on "Proof Tests and Proof Marks," which first appeared in this publication in 1933-1934 is still in great demand.

Winchester Agent

But, alas, Dr. Williamson's lively interest in balance sheets takes over early in the volume, and few other zestful yarns adorn his text. We do learn how, in 1866, T. E. Addis, a resourceful Winchester agent, managed, after delivering a consignment of rifles to the Mexican Government, to make his way safely by stagecoach through a bandit-infested country from Monterey to the American border with $57,000 in silver coin.

Stabbed Himself

To keep himself awake on the long trip he stabbed his thigh frequently with a scarf pin. This again is a classical Winchester tale, though the stickpin feature was to me a new and added attraction. Appearing on page 54, it just about lowers the color curtain on the worthy doctor's volume. Thereafter almost everything is in dull black and white, and concerns contracts, lawsuits, the buying out of competitors, intra-shop contracting, markets at home and abroad, the development of new models, relations with inventors, especially John M. Browning, entanglements with banking concerns, World War I commitments, subsequent efforts to develop new lines of merchandise and means for marketing these, and, finally, in 1931, failure, receivership, and the beginning of a new and outstanding era with purchase of Winchester, "its properties, assets, business, and good will," by Western Cartridge Company—now Olin Industries, Inc.

Clearly delineated are the histories

of the various men whose impact on Winchester was direct and important. First among these was Oliver F. Winchester, dynamic president of the New Haven Arms Company (organized in 1857) which in 1867 became the Winchester Repeating Arms Company.

There had, of course, been other weapons, ancestors of the Winchester, the earliest of these being the Hunt repeater with its self-propelled bullet (1849). Immediately thereafter came the Jennings (also 1849) and then, in 1854, a simplified action firing a similar bullet and made by none but our old friends, Smith & Wesson, first in Norwich, Conn., and later in New Haven.

Interest Sold

In 1855, Smith & Wesson sold out their interest in the manufacture of repeating pistols and rifles (but *not* of revolvers) to the Volcanic Arms Company of New Haven, which undertook to carry forward production of these types of weapons.

Oliver Winchester was a stockholder in the new company. When it failed in 1857 he acquired its assets and organized the New Haven Arms Company, with B. Tyler Henry, who had worked for Smith & Wesson, as plant manager.

Again the same line of arms and ammunition was manufactured, but the latter was basically defective. Henry set to work, devised (1860) a new cartridge and a new rifle, both of which were to bear his name until succeeded by the '66 model Winchester, the first of the long line that has made Winchester a household word.

Errors Found

In a fairly close scrutiny of Dr. Williamson's work I discovered around 80 errors of omission or commission, slightly less than one every six pages. This I consider far from excessive. I confess that when as early as page four I came upon a proper name and a place name, both misspelled, I had serious misgivings as to what might follow. Happily, these were not confirmed.

There were, of course, other misspellings; passages so unclear as to convey (to me at least) no real meaning; word usages revealing unfamiliarity with the technical vocabulary of the arms industry; errors in dates (*e.g.*, 1899 for 1889 on page 125), in description of techniques (graphite is *not* used as a deterrent for coating powder grains, page 140), etc.

On page 217 we find mention of the activities of the Hiss-tainted Nye Committee of evil memory.

Here Williamson has muffed an opportunity to reveal the sinister background behind that group. Also, he is ten years off in his chronology. (Winchester, as a matter of fact, presented an excellent refutation of the Committee's charges.)

On page 220 the author refers to French 7-mm. small-arms ammunition when he obviously means 8-mm. On page 270 $8 million is apparently an error for $8 billion. Twice on page 243 we find the Lewis machine gun described as a "Servis" gun (probably due to incorrect reading of a holographic text). And so on.

Reference Section

All reference notes are gathered together in a 25-page section toward the end of the volume. This causes unnecessary bother, since they are not so numerous but that they could have been appended to the bottoms of pertinent pages. I find them additionally frustrating because Williamson, in reference to a book, gives only the author and title. Unless date and place of publication are also supplied, we frequently get nowhere. When referring to magazines, he furnishes the name of author and publication and month of issue—still not enough by my standards.

Twenty-eight pages are devoted to excellent illustrations of various models of Winchester arms, their forerunners, and products of certain rivals purchased by Winchester over the years. Nine more list all types of metallic ammunition ever made by Winchester, with certain descriptive data on each, but not enough. (More on this, later.)

With the appendix on cartridges already mentioned, I have a big crow to pick. Here Williamson could have insured a one hundred per cent increase in the sale of his book had he undertaken to cater to the large company of cartridge collectors that exists in this country and supplied case lengths in *all* instances (he does in some), weights of black-powder loadings, all bullet weights and types in which each item was produced, and years when discontinued items were withdrawn.

Some of his figures are questionable. Thus he gives as 217 grains the weight of the .44-40 WCF bullet, which has been known as the (.44-40-) *200* since the memory of man runneth not to the contrary. He employs, without explanation, many abbreviations which will be unintelligible to other than the ammunition devotee.

And compounding all other errors, he lists the .70-150 Winchester cartridge as "introduced in 1888"—period! Every cartridge fan who has ever seen or heard of a .70-150 Winchester cartridge has obviously been holding his breath in expectation that this volume would solve that mystery of mysteries: What model handled the .70-150? Who was responsible for developing the cartridge and the weapon? Why was it never advertised—or was it?

And in answer to these questions we get, on page 455, a simple listing of this cartridge, starred to indicate that Winchester developed it; nothing more. By contrast, the story of the One of One Thousand, and the less noteworthy One of One Hundred, Winchester is set forth in relatively full detail.

Sample Models Listed

New to me, and of extreme interest, was the account, with illustrations, of various sample models of revolvers made up between 1876 and 1884 but never put into production.

So don't misunderstand me, the volume is a big ten dollars' worth—so long as you are *not* buying it as a source book on the Winchester line of small-arms ammunition.

(Here's a secret. The real story of the .70-150 cartridge and scores of other relatively unknown types of Winchester metallic ammunition appears in the sixth edition of "The Gun Digest," Chicago, 1951.)

Navy photo

Submarines in 1963

A Prediction of Things To Come in Underseas Warfare

Rear Adm. C. B. Momsen

IT is now possible to predict the nature of submarine warfare of the future. We can do this by a careful analysis of the worldwide past performance of submarines, by reviewing the current capabilities of submarines and antisubmarine systems, and by realistically assessing the capabilities of new weapons, equipments, and techniques now under development.

Enormous Toll Taken

It is hardly necessary to go into great detail to point out the enormous toll of surface ships that submarine weapons have taken in enemy oceans of the world. However, it is well to remember that more than fifty-four per cent of the Japanese merchant and naval tonnage lost in World War II was sunk by United States submarines! Yet the submarine service employed less than two per cent of all U. S. naval personnel.

On the other side of the ledger, the Allies lost 2,750 merchant vessels, totaling 14.5 million tons, to Axis submarines during World War II. This is an even more impressive figure when one realizes that Germany started the war in 1939 with only sixty submarines, half of which were small coastal units.

Admiral Momsen is commander, Submarine Force, United States Pacific Fleet.

The opinions or assertions contained herein are those of the author and are not to be construed as official or reflecting the views of the Navy Department or naval service at large.

Threat Controlled

Our antisubmarine efforts finally brought the German submarine threat under control near the end of the war, but only at a cost of approximately $100 billion in antisubmarine measures alone and the diversion of approximately 25 per cent of our entire national defense effort.

It will suffice to say that on the basis of dollars expended submarines have created much greater destruction in terms of war-making potential than

that caused by any other form of warfare. The one exception to this is mines, but it must be pointed out that the use of mines is limited to shallow and restricted waters.

Two Questions

With regard to sea power in 1963 we can pose two questions: (1) What will the submarine of the future look like? and (2) What methods are now known or contemplated for dealing with this new monster of the depths?

Before considering these two questions I would like to dwell briefly on a more fundamental question, "Why sea power?"

Much has been said about sea power, the show of force, the protection against piracy, stabilization of trouble spots in remote areas, etc., but in the final analysis sea power's most potent impact upon world affairs appears in the form of sea transport. It means sufficient force to insure free use of the oceans to transport men and freight. It means the ability to concentrate by sea transport superior military power in weaker areas.

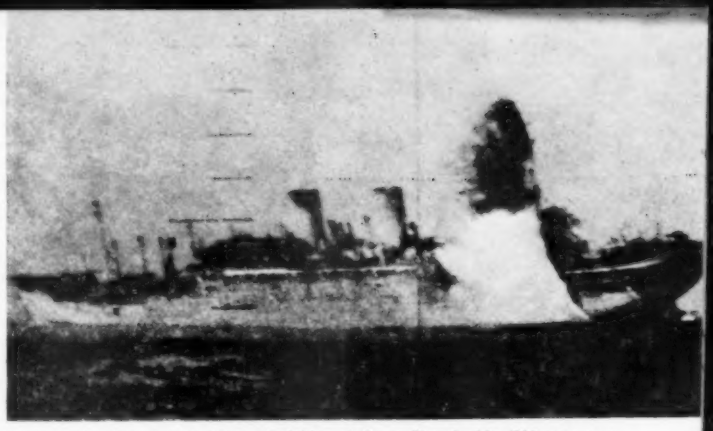
Relatively speaking, the United States of America is an island. Except for our traditionally friendly neighbors to the north and south, we are surrounded by vast oceans. We require sea transportation for our industry and for our protection. We need it to assist our allies. We cannot remain a great nation and be isolated from the rest of the world.

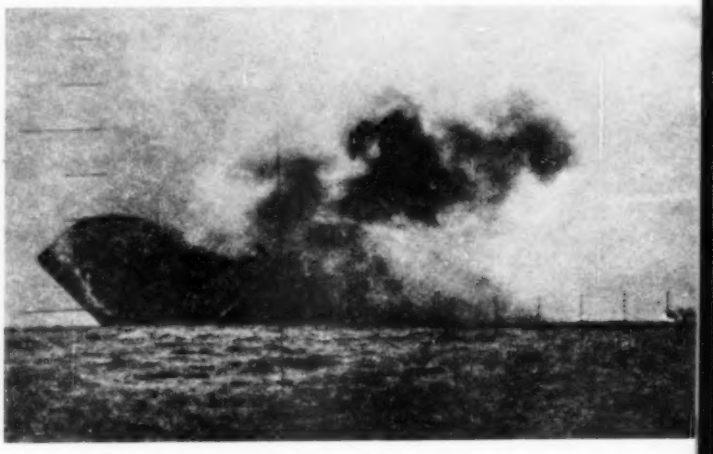
On the other hand, a large nation located in the great land mass of Europe, Asia, or Africa could remain strong even though "isolated" from the Western Hemisphere. In this vast area practically every need for industrial development and military operations might in time be transported by land.

It is true that supply by sea would be very important to them, especially along the coasts, but not as vital as it would be to us.

To Our Disadvantage

It follows, then, that any weapon that strikes at the sea lanes and makes them unusable could serve the purpose of isolating either nation, and this would be more to our disadvantage than to theirs. One such weapon is the submarine.





Above and below, the attacking and sinking of the ex-French ship, D'ARTAGAN, as seen through the periscope of the U.S.S. PUFFER during World War II (Navy photo).

Subs Defy Fleets

In the past it has been clearly demonstrated that submarines can operate in the face of powerful surface fleets, and they have several times nearly driven water transportation from the high seas.

Now let us examine our past experience in dealing with the submarine.

By expending huge sums of money, material, and men the Allies did succeed in defeating the German submarine in World War II. The principal contributors to this victory were aircraft with radar and homing weapons, surface craft with ahead-thrown weapons and depth charges, and air and ground forces' destruction of the German capacity to build replacement submarines.

Yet at the end of the war the submarine was suddenly reborn, in so far as its concealment was concerned, by the introduction of the snorkel. We were fortunate that this novel device came too late, for the German war machine was already aground and breaking up.

Underwater Endurance

While I do not believe the snorkel will play a vital part in the submarine of 1963, it does point to the need for greater underwater endurance in order to escape from the radar's magic eye. It must be remembered that radar cannot penetrate water and would be of no value in locating a completely submerged submarine.

True, we had great difficulty in locating the snorkeling submarine near the end of World War II, but on the

other hand these submarines had equal difficulty in locating targets, and thus in spite of this startling innovation (the snorkel) our losses fell off to insignificant figures.

Classified Information

It will not be permissible to divulge classified information in an article of this nature, nor is it necessary in order to present a clear prediction of the capability of the future submarine. Classification is, in most instances, a means of buying time, for once a weapon or weapon system is exposed in war it becomes only a matter of time for the enemy to develop and produce similar weapons or systems or to prepare countermeasures.

What then can the submarine have in 1963 that will change the picture? Three principal changes could be, first, long submerged endurance; secondly, high submerged speed; and thirdly, improved fire control.

Let us first consider long submerged endurance. Power plants that require oxygen for combustion for their fuels use great quantities of air, and even if the oxygen were used in its pure form compressed to high pressures or liquefied, the amounts that could be carried inside of a submarine hull would be comparatively small and the endurance of submerged operations would be rather short.

Of course, the snorkel as developed by the Germans can supply sufficient air but when using the snorkel the submarine must remain near the surface. Furthermore, the snorkel head can be seen by eye or radar, and the submarine thus loses its most valuable asset—concealment.

The nuclear power system is not dependent on air or oxygen. Other types of propulsion systems under development are also not dependent on air. The power plants of 1963 would permit submarines to remain deeply submerged for days on end if necessary.

The "Loon" guided missile, above, is launched from the submarine U.S.S. CUSK. Below, latest attack-type submarine, U.S.S. TANG, moves into its berth (Navy photos).

Weight Saving

Another important change that would result from the new power plants lies in weight saving. World War II submarines carried a dual power system. Their Diesel engines, used for running on the surface and for charging storage batteries, weighed about a hundred tons. In addition the submarine carried about 210 tons of storage batteries for operating submerged. Obviously, if a single power plant can replace the dual system a substantial saving in power-plant weight and space would be possible.

The new power plants lead to the second important change—high submerged speed. In addition to the radically increased power which will be made available for submerged propulsion, by the use of new power plants it will be possible to utilize better shaped hulls for the future submarine.

It is a well-known fact that one of the principal power losses of ships is caused by the bow wave. In order to minimize the effect of bow waves, surface ships are made narrow in beam as compared with their length.

Bow-Wave Effect

If the hull is completely submerged the bow-wave effect is reduced and continues to become less as the depth increases. Future submarines will be broader of beam and shorter in length since we will not be so much concerned with bow wave and the larger beam-to-length ratio gives a more efficient underwater shape.

The importance of these changes will be that the completely submerged submarine of the future will be capable of making more speed with a given amount of power than a surface ship with an equal amount of tonnage. Sub-

marines of the future should be able to make higher speeds than are now attainable by surface ships, and should high speed become a tactical necessity the submarine should be able to attain speeds up to 50 or even 60 knots.

Fire Control

The third important change, which becomes necessary by reason of the new concept of submerged operations, is in fire control. Fire control includes the location, attack, and destruction of enemy surface ships and submarines.

The new submarine will depend more upon information obtained by sound equipment and will be required to attack from a completely submerged position. These things will be made possible by vastly improved sound equipment and by homing weapons.

Detection by sound employs both passive and active systems. Passive sound is the mere listening to a noise made by an enemy ship. If the enemy ship is not producing noise, as in the case of a silently operating submarine, then the system used is termed active and consists of projecting sound signals into the water and listening for a return echo from the target. Both of these systems are being greatly improved.

"Homing" Weapons

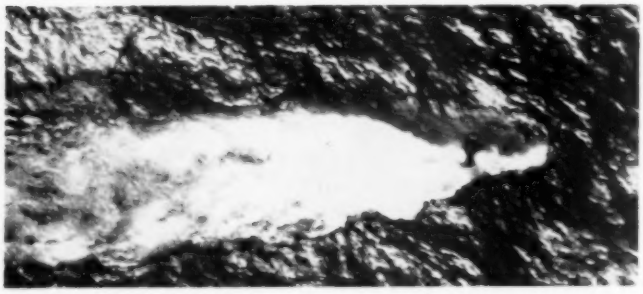
Since the information obtained through sound is not as accurate as radar for range and the periscope for bearing, new types of weapons which require less accuracy in aiming will be used. Some of these weapons are termed as "homing."

A homing torpedo either listens for a sound source or uses echo-ranging technique to locate its target. It then seeks out the target by following the noise.

Pattern-running torpedoes promise another means of attacking on sound information alone. These torpedoes follow a preset pattern which covers all probable positions of the target.

Dangerous Weapon

With the scientific knowledge now available in this country the submarine as a weapon could be made far superior and more dangerous than anything now in use anywhere in the world. In this country our industry is motivated by profit. Since there is no commercial requirement for submersibles, the development of the submarine is not supported by great segments of industry, as for instance is the development of the airplane, the surface ship, and motorized land vehicles.



With only its distinctive air intake visible, a modern snorkel submarine is shown traveling at about 8 knots, leaving a noticeable wake (Navy photo).

Progress Forced

Progress in submarine development has been forced upon us by necessity and must be supported entirely by funds appropriated to the Navy by Congress. The assignment of funds within the Navy is highly competitive, and the submarine service must stand in line to get its share.

If the power that is available from our national industrial capacity were applied to submarine development the 1963 model could be made a reality with ease.

The 1963 model submarine could be a formidable foe against surface ships of all types. If it had been possessed by our enemies in 1917 or 1942, our war effort could have been stopped cold and the map of the world would now be very different. I suppose one could say that if Genghis Kahn had half a dozen modern machine guns in his army the world today would be peopled entirely by Chinese!

Fortunately things don't happen that way. Human intelligence is being applied to the problems of new types of warfare and to the development of countermeasures as rapidly as new devices appear. There has always been a delicate balance between measures and countermeasures. When a new weapon or device appears as a surprise it may upset this balance for a critical period. Examples of this are numerous.

Surprised Japanese

For instance we surprised the Japanese by the introduction of radar. The Japanese did get radar but not until its use in our submarines had severely crippled her maritime power.

The Germans introduced the magnetic mine as a surprise, and the results were devastating until the British caught up with countermeasures.

Another example was our use of homing torpedoes against German submarines. In this instance time ran out on the Germans before they were able to develop a countermeasure.

The proximity fuze for shells is another classic example of a new development which caused profound results as long as the secrecy lasted. There have been many others and undoubtedly there will be many more.

One of our most serious problems of today is the development of a means to counter the submarine of the future. Before discussing that, however, I would like to correct the impression sometimes expressed by pseudo experts that since our potential enemy does not have a big navy and merchant marine there is no need for us to continue to maintain the leadership in submarine development.

Wrong Attitude

This attitude could not be more wrong. We can never keep up with countermeasures against a future sub-

marine menace unless our antisubmarine forces are opposed in peacetime maneuvers by the best submarines that human ingenuity can devise and unless they are manned by the most intelligent and enthusiastic personnel obtainable.

Antisubmarine Warfare

As a result of our aggressive submarine development, antisubmarine warfare measures of the future are taking form now. Several new ideas stand out and are already well known.

In addition to war-tested antisubmarine systems such as depth charges, mines, ahead-thrown weapons, aërial bombs, and target-seeking torpedoes—all of which will be used in the future—there are three new approaches to the problem. These are the use of helicopters, new types of weapons, and the SSK or Submarine Killer.

New weapons which will appear promise to be revolutionary as well as effective.

The SSK is a submarine designed to destroy other submarines. Although the idea is not exactly new, it is being developed rapidly and the new type will become the most feared foe of the prowlers of the deep.

Its function is simple and straightforward. The attack submarine in searching for targets must travel great distances and to close its prey must move swiftly into attacking position.

We, on the other hand, know where our ships are going and can have Killers placed in strategic positions in anticipation of their passage. These Killers can lie in wait quietly—they are not committed to long underwater journeys.

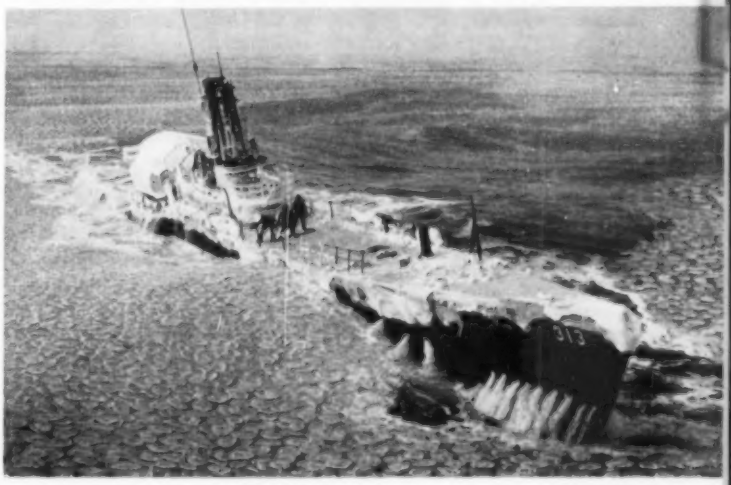
Killers Have the Edge

With new and powerful listening equipment now being turned out by our scientific laboratories, our Killers will nearly always have the edge on an adversary. Ship for ship, the SSK will take a heavy toll of enemy submarines.

In the past it has been said that a surface ship can perform better any task that a submarine can do—except dive. Perhaps we will say of the future submarine that it will perform better any task that a surface ship can do—*and* dive!

The K3, above, one of the first submarine killers designed for antisubmarine work. Below, conventional-type sub streamlined to increase underwater speed (Navy photo).

The U.S.S. PERCH, below, runs through pancake ice during Alaskan duty (Navy photo).



Military Command or Management?

Ideal Philosophy Adopts the Best Features of Both

by

Capt. John D. Hayes, U.S.N.

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"The complex units that comprise the military organizations today cannot be just 'commanded.'"

A REVOLUTION in the methods of warfare occurred between 1942 and 1945. This revolution took the form of applying industrial potential to military needs. The ability of Americans to produce war materials in vast quantities and to manage large supply lines enabled our combat people to apply the military principle of mass in a new manner. Logistics rather than strategy or tactics was used to assure victory.

Industrial Potential

Today this same industrial potential is being used to broaden our military base and to increase our military posture. In the present "cold war," strategy and diplomacy have become sort of dependent variables of economic mobilization. Logistics, both military and national, has come into its own and now has equal status with strategy and tactics in the trinity of warfare.

Two radical changes, important to our national security today, are results of this revolution in warfare. The first is that military organizations have become complex products of our industrial society, with the result that military men now also ply their trade by mass-production methods.

The second is that the positions of the civilian and the military in warfare are no longer sharply defined. Both have responsibilities for national security. Both have to share the burden of war and suffer its effects.

The increased importance of logistics in relation to strategy and tactics, the complexity of modern military organizations, and the elimination of the sharp difference between military and civilian in warfare all indicate that a new appraisal should be made of the directing function in military organizations. Command normally is associated with military leadership. A good commander is conceived as one who can appraise a situation rapidly and make prompt and correct decisions. This is the primary attribute in the sphere of tactics.

In strategy, more reflection can be given to decision making, and in the area of diplomacy and foreign relations we Americans prefer decisions reached by "wise men" to those made by "kings."

In logistics and in economic mobilization, command alone cannot accomplish the over-all direction necessary. In warfare generally, Americans pride themselves on having been consistently successful without the complete need for the military genius of great commanders like Napoleon or Nelson.

Wide Connotation

Actually, do we really mean "command" when we apply it so readily to military enterprises today or are we talking about some broader form of military direction? The word "command" today seems to have been given a wide connotation by the military profession. It is used only infrequently now in its narrow sense of immediate response to the will of the leader.

In the Navy, for instance, there is little in common between the command of a ship and the command of a large naval base. Similar comparisons may be drawn in the case of the other services.

My thesis is that, despite the profession's love for the word "command," amounting to almost a fetish, the complex units that comprise the military organizations today cannot be just "commanded." Some other form of direction is needed—direction of the type which is loosely included under the term "management." The vast majority of officers today are in fields of endeavor where attributes of good managers rather than good commanders are required.

Definition

The difference in meaning in the two words, "command" and "manage," will be revealed by any good dictionary, but something better than a dictionary meaning is available for our purposes. Henri Fayol, the great French industrial philosopher, gave a definition of management which is quoted in almost every text that has anything to do with this subject. Management, for Fayol, is an inclusive term. It contains five elements: forecasting or planning, organizing, commanding, coördinating, and controlling.

To Fayol, command means to maintain activity among the personnel of an organization. The authority to effect such activity is implied. His definition of the other elements are: foresee and plan—to examine the future and draw up a plan of action; organize—to build the dual structure of men and materials; coördinate—to bind together, unify, and harmonize all activity and effort; control—to see that everything conforms with established rule and expressed command.

Each and every one of these elements of management is needed in

modern military organizations. Neglect of any one means at least confusion and possibly disaster. Military operations themselves are now conducted more by controlling than by commanding, and the former term is coming more and more into military use. During World War II, planning and organizing became major military duties. Integration of military purpose in the National Security Act has given increased importance to coördination.

"Manage" is a more encompassing word than "command" but it does not entirely include it, and for this reason it has limitations for military purposes. "Command" indicates the authority and the assurance of getting the job done, which is the all-important consideration in military operations. The meaning of "management" and "to manage" does not go that far. "To manage" has been defined as "to conduct affairs; *i. e.*, to guide them in a unified way to a definite goal or to direct or control people, often by tact, address, or artifice" (American College Dictionary, Random House, 1951).

"Command" on the other hand presupposes authority with its inspection and disciplinary prerogatives. Management in American industry does not possess such powers, a fact that must not be forgotten in considering industrial management methods for military purposes.

Many Lessons

Despite its limitations, industrial management has many lessons to teach the military. For one thing, industrial management has received a great deal of scholarly attention. A science of organization and administration has been developed, a copious literature exists, and the subject has been given much attention in our universities. A knowledge of the principles of management is almost a prerequisite for an industrial leader.

The elements and principles of management have been well defined in the works of the several writers who are recognized as authorities and philosophers on this subject. These include Frederick Winslow Taylor, M. Fayol already mentioned, Mary Parker Follett, James D. Mooney, Alan C. Reiley, and L. Urwick.

A great need of the armed services today is a literature on military organization and administration. There are copious works on strategy and tactics. There is a growing literature on logistics and economic mobilization. The large literature on industrial management has already been mentioned.

But the best material existing on military management is contained in the conclusions and recommendations of the Pearl Harbor Report entitled "Supervisory Administrative and Organizational Deficiencies in Our Military and Naval Establishment Revealed by the Pearl Harbor Investigation." A whole science of the subject could be built around the twenty-five deficiencies listed therein.

Little Positive Material

On the positive side, little material exists, and the best of it was written many years ago by such writers as General Upton for the Army and Admiral Luce and the historian, Charles O. Paullin, for the Navy.

Despite the similarity between modern military and industrial organizations, the word "command" is never used in industrial or business organizations. This could be explained with a statement that labor unions or American workmen generally would never permit it. Nevertheless there was a time when command in its most positive sense was common in industry. The strong personalities who were the original industrial leaders, their line bosses and foremen, were commanders in every sense of the word.

In fact, the original purpose of Frederick Winslow Taylor, the father of modern management, was to replace the line system with what he claimed was the more efficient scientific management which in effect was specialization carried to a high degree. Taylor contended that few men had all the attributes necessary for a good commander. He listed these attributes with refreshing simplicity: brains, education, special and technical knowledge, tact, energy, grit, honesty, judgment, common sense, and good health.

The opinions and assertions expressed in this article are those of the writer and are not to be construed as official or as reflecting the views of the Navy Department, the Naval Service at large, or the Industrial College of the Armed Forces.

Divide Responsibility

Men who have four or five of these ten qualities, Taylor claimed, are found rarely, and those with six, seven, or eight are almost nonexistent. An organization demanding all these qualities in men must make some provision for division of the responsibility load.

Division of the responsibility load or functional responsibility is the basic tenet of industrial management today. The large-scale decentralization and specialization characteristic of American business are thereby possible. Decentralization and division of authority are carried so far in American industry that often important functions are delegated entirely outside the organization.

This delegation or dependence beyond one's direct control, common to normal day-to-day life in our complicated modern society, is something which a professional officer finds hard to accept for military organizations. "Supply must be responsive to command" is a cliché often heard. When any sort of functional responsibility is advocated for a military setup, the question sooner or later arises, "Who is to be in command?"

The "exception principle" of management, first identified by Taylor, is followed generally in American industry but much less so in military or government organizations. Under such a system only summarized and comparative reports reach the executive. The industrial executive does not expect to be informed just for the sake of being kept informed for soon he would be doing nothing else but receiving information.

Here is where the sin of pride of the commander often affects the efficiency

of complex military organizations whose main function is support. It is one thing to be kept informed when commanding a ship under way or a regiment in combat. It is something else again to be appraised continually of all the multitudinous details of a logistics command. It is unlikely that our large corporations and industrial establishments could ever have reached their present size with efficiency if the principle of decentralized responsibility had not been accepted.

Important Difference

The most important difference, perhaps, between military and industrial organizations today is that in the latter the situation rather than the personality is the dominant control factor. The situation controls, and the true leader is the one who responds immediately and effectively to the situation. Since it is the situation that is always primary, authority is derived from function rather than position. Responsibility is *for* and not *to*.

This principle was first recognized by Mary Parker Follett and is called the "Law of the Situation." Realistic American industrial management has long accepted it. Control is in methods rather than in men as is indicated by such terms as budget control, inventory control, and quality control. Authority is diffused. Command is considered as the emergency element of management, to be used only when the others fail.

Management as it is understood in industry cannot be adopted blindly for military organizations, even for those which are most similar. Comparable industrial and business organizations are generally less complicated than those in the defense establishment, their purposes are usually more limited, and their responsibilities are certainly less.

Some Failures

Industrial management has had some notable failures. In certain crises it has been unable to get its job done, and in these days when industrial production and national security are so interrelated, this is critical. Most of these failures when analyzed can be attributed to a too-narrow interpretation and use of the command element. American industry is still unable critically to inspect and police itself.

James D. Mooney and Alan C. Reiley, American industrialists writing on this subject, have pointed out that in all forms of organization three main divisions can be distinguished. These are the determinative or legislative, which decides on policy; applicative or executive, which places that policy into effect; and the interpretative or judicial, which investigates performances and imposes penalties as needed. Modern industry has developed the first two of these divisions to a high degree;

it has ignored the third. Because industry has failed to inspect and police itself, because it ignored the interpretative part of organizing, government with its regulations and labor unions with their demands have moved into this void. The military services with their age-old experience in handling men have always been ahead of industry in the personnel field.

Beware of Panaceas

The armed services, even for their quasi-military organizations, should be cautious about adopting management methods exactly as they are applied in industry. They should be especially careful about accepting panaceas or the diagnosis of "experts" as easy solutions for their management problems. Nevertheless the practice of placing reliance on outside professional help has proved fruitful especially in military research and development.

Similar results could be attained in the management field, but efforts in this direction have not been attended with too much success to date. This is unfortunate. Industry has an advantage not available to the military. An industrial organization is daily performing the function for which it was created, whereas the soundness of a military concept or organizational principle can only be given its final test in war.

In the meantime one of the hardest jobs of a military officer is to remain realistic and not adopt a subjective point of view. To help himself he should be searching constantly for a base line with which to measure his own position. In the field of organization and administration, modern American industry offers such a base.

Confidence Gained

Management consultants have gained the confidence of business and industry, and they should be able to help the services. To do so they must first understand the complexities, traditions, and purposes of military organizations and how they differ from the nonmilitary. This takes experience, patience, and time. Meanwhile both parties, consultants and officers, should strive for wholehearted coöperation that makes for mutual respect and firmer conviction. A too-hurried and superficial approach may result in setting back for years the adoption of appropriate management principles in military organizations. Industry is still recovering from the bad reputation that the "efficiency experts" gave to the doctrines of Taylor.

Command alone as a directing element no longer suffices for modern complex military organizations. Industrial management methods, on the other hand, have severe limitations. But a philosophy of management does exist, and an excellent literature on it is available. The solution to service management problems seems to lie not in adopting management methods of present-day industrial organizations but in deriving its own management methods from this philosophy.

Literature Needed

We need, and the hour is already late, a literature on military management based on objective and scholarly study. In the meantime none of us can go wrong in reading the excellent but short informative works of L. Urwich and Henri Fayol or the longer, reflective works of Mary Parker Follett, Frederick W. Taylor, and of James D. Mooney and Alan C. Reiley. To these may be added the one pleasant and readable military prophet of this subject, Sir Ian Hamilton, who, a generation ago in Great Britain, preached a doctrine of military unification.

Two New Aircraft

The U.S. Navy's P2V-6 Neptune shown above is specially designed for antisubmarine warfare and mine laying. It is equipped with secret armament, sensitive radar, and a high-intensity searchlight on the right wingtip. The long-secret crescent-winged Handley Page 80 Victor below, powered by 4 Sapphire jet engines, is the latest of Britain's heavy bombers (British photo).

Month by Month: Highlights of the National Defense

Stand-by Capacity

The Special Advisory Committee on Production Equipment, headed by Harold S. Vance, president of the Studebaker Corporation, recently completed a 6-month study with a report that advocated stand-by production capacity for defense rather than the stockpiling of weapons and equipment.

Holding that "the capacity to produce is, in fact, a military reserve of the highest order," the Vance Committee stated that a program of building and maintaining standard production capacity would be more effective and more economical than the storing of arms that would become obsolete.

But plants also become obsolete. The Committee's reply to this objection is that even such plants can conceivably do an effective job in producing up-to-the-minute equipment. Even granting the force of the argument, the Committee believes that facilities can be kept up to date at a fraction of the cost of modernizing military equipment.

Which shall it be: planes or the facilities to build planes? Which is the better policy for defense-mobilization purposes?

The Committee voted for the tools rather than the planes and cited Air Force policy as a timely illustration.

The Air Force, by arranging to buy $500 million worth of long-lead-time forging presses and other complicated and massive production facilities, has added about $1 billion to the volume of aircraft it can expect to receive in the first two years of an all-out war.

The Committee noted that this "insurance program" means that the Air Force has sharply reduced the number of planes it must stockpile, has cut the risk of losses through obsolescence, and has saved the Nation a substantial outlay of funds in advance of actual mobilization.

Other members of the Vance Committee were Clay P. Bedford, president, Chase Aircraft Company; Adm. W. H. P. Blandy, president, Health Information Foundation, a vice-president of the American Ordnance Association and World War II Chief of Navy Ordnance; Lieut. Gen. LeRoy Lutes, president, Pacific Tire & Rubber Company and Director of Operations, Army Service Forces, during World War II; Rear Adm. Lewis L. Strauss, consultant and financial adviser to the Rockefeller family and former Atomic Energy Commissioner; Lieut. Gen. K. B. Wolfe, president, Oerlikon Tool & Arms Corporation of America and former chief of Air Force procurement; and Manly Fleischmann, former Defense Production Administrator.

The Committee recommended that the following three steps be taken to carry out its program:

1. That the Government take every means at its disposal, where deficiencies exist in capacity to produce heavy production equipment, to stimulate the creation of the needed capacity by private industry. If these efforts fail because the capacity needed is found to be commercially nonsupportable, the Government itself should create and maintain this capacity.

2. That the Department of Defense set up specific procedures to insure a more effective coördination of activities relating to the production-equipment and facilities phases of military end-items production programs. Other executive agencies should also take the necessary action to comply with the policy.

3. That Congress be requested to take whatever action is needed to confirm and support the policy. (More on the Committee recommendations will be published in subsequent issues of ORDNANCE).

Continental Defense

The Department of Defense has announced the appointment of a temporary committee to advise the Secretary of Defense on certain aspects of the problem of defense of the North American continent against possible atomic attack.

The membership of the committee is as follows: Chairman, M. J. Kelly, president, Bell Telephone Laboratories; Walker Cisler, president, Detroit Edison Company; S. C. Hollister, dean of engineering, Cornell University; F. L. Hovde, president, Purdue University; C. C. Lauritsen, professor of physics, California Institute of Technology; Arthur E. Raymond, vice-president, Douglas Aircraft Company; H. S. Vance, chairman of the board, Studebaker Corporation; and R. E. Wilson, chairman of the board, Standard Oil Company of Indiana.

The committee will concern itself with over-all Department of Defense policies and programs aimed at achieving a more effective condition of continental defense. It will also study the possibilities of improved methods of warning of hostile attack and the relation of such warning systems to other major continental defense measures.

Report on Arms Production

The volume of production of military supplies and equipment is now almost seven times what it was when Korea was invaded. Deliveries of all categories of munitions, plus construction, are now about $8 billion per quarter. These and the following facts are disclosed in the final report of Henry W. Fowler, director of Defense Mobilization, dated January 1, 1953.

The dollar value of deliveries of guided missiles is currently running over twice that of third-quarter-1950 deliveries, but technical difficulties, design changes, lack of technical personnel, and other production problems continue to retard quantity output.

Using guided missiles that have come from assembly-line production, the Army plans to begin in 1953 the or-

ganization of antiaircraft battalions equipped with the Nike surface-to-air missile, and the Air Force plans to equip its first pilotless bomber squadron with the surface-to-surface Matador B-61 pilotless bomber.

Production of the medium tank, which in dollar terms is the most important combat vehicle in the Army procurement program, has reached a stage which is typical of a wide range of Army items. Designs have been perfected, production facilities are almost completely equipped, and a high rate of output of both the M47 and the newer Patton 48 has been attained.

Most of the medium-tank production planned for 1953 will be continued on schedule. Later production will be stretched out. By mid-1954, the country's tank plants will be operating at only a small fraction of capacity, but the maintenance of going lines would permit rapid expansion.

In the past 2½ years, large numbers of a modern light tank—the T41—also have come off the production lines. The development stage on a new heavy tank—the T43—is completed, and deliveries of the production model will begin soon.

One measure of progress in the development of new weapons is the increase in firepower. At the present time, one of our infantry divisions has seventy-five per cent more firepower than a World War II division, although its personnel is only thirty per cent greater.

A great advance in the Army program has been the successful development of the new 280-mm. gun—the largest-caliber artillery piece having complete mobility. Now in limited production, this gun is designed to fire both conventional and atomic shells.

Due to the continued drain on World War II stocks imposed by the Korean fighting and limited replacement from new production, the Army worldwide supply position on several ammunition items has deteriorated.

The Department of Defense is pushing the completion of new facilities and initiating a further facilities expansion so that a satisfactory supply of artillery ammunition can be restored and maintained. The needs in Korea, meanwhile, have been given first priority in the distribution of existing stocks.

In place of the many different sizes of trucks used by the services in World War II, the Department of Defense has standardized production on four sizes—the ¼-ton jeep, ¾-ton, 2½-ton, and 5-ton.

About half of the total number scheduled to be produced under present appropriations have been delivered, and production rates from this point are scheduled to decline slowly.

MARINES ABANDON CARBINE

The complete elimination of the carbine from all Fleet Marine Force units has been ordered by the Marine Corps.

All enlisted personnel in ground units, except master sergeants and petty officers, previously armed with the carbine, will be reëquipped with the M1 rifle. Commissioned and warrant officers, master sergeants, and chief petty officers previously equipped with the carbine will be issued pistols.

Supersonic Wind Tunnel

A new wind tunnel will be installed at Aberdeen Proving Ground this year, capable of producing air velocities equivalent to 3,700 miles an hour.

This supersonic tunnel, now being constructed by the Shipbuilding Division of the Bethlehem Steel Corporation at Quincy, Mass., will incorporate the latest engineering and aërodynamic features now known.

The tunnel will have a 13- by 15-inch test chamber and will be of the flexible-nozzle type which permits velocities between one and five times the speed of sound.

The new tunnel, costing about $350,000, has been designed with an eye toward eliminating undesirable features of earlier tunnel designs. It will have a broad speed and density range, a very uniform air flow, and an extremely precise force and moment measuring system.

Past experience in the operation of supersonic wind tunnels and the requirements for higher measuring accuracy have been important guides in this new design.

The old tunnel used at Aberdeen will be used at Redstone Arsenal, Huntsville, Ala., to do preliminary investigative work. Final stability and design data will be derived from advanced tests to be conducted in tunnels similar to the new flexible-nozzle tunnel at Aberdeen.

Call for Reorganization

In his final report as Secretary of Defense, Robert A. Lovett asserted that the National Security Act, the master blueprint for the Nation's defense machinery, was an inadequate law that could not stand the strain of an emergency. His criticisms included the organization of the Joint Chiefs of Staff and the technical services of the Army.

Speaking of the need for reorganization, Mr. Lovett said:

"Certain of the desirable steps would appear to require legislative action to make them fully effective," the Secretary's report states, "and clarification of some of the language in the existing statutes seems essential if the smooth functioning of the Department is to be assured under the strains imposed by a higher degree of mobilization, which would inevitably involve magnified problems in connection with the 'distribution of shortages'—one of the primary problems that must be solved by any Secretary of Defense."

According to Mr. Lovett, the problems range from what appears to be excessive rigidity in the language of the National Security Act of 1947, as amended in 1949, to purely administrative and organizational problems. Practically all of them, he pointed out, involve the need for greater flexibility in order to meet changing conditions.

With regard to the statutory agencies, such as the Munitions Board, Mr. Lovett expressed the view that the Board could not effectively discharge assigned functions because each member of the Board, except the chairman, "is both a claimant and a judge of his own requests."

He expressed the hope that efforts would be continued to make the organization of the Department of Defense "as modern as the world we live in."

All the effort and treasure poured into rebuilding our defenses and the sacrifices of our armed forces in Korea "will be wasted," he declared, "if we fail to have the fortitude and singleness of purpose to stay steady on our course in search for peace through strength."

In his recommendations regarding the Joint Chiefs of Staff, Mr. Lovett suggested two alternate plans, the second "more radical" than the first:

1. Confine the JCS to planning functions and the review of war plans in the light of new weapons and techniques, transferring the balance of present military staff functions to the office of the Secretary of Defense who should be provided with a combined military-civilian staff.

2. Change the make-up of the JCS to a membership of senior officers, each of whom has served as a chief of staff of one of the three services. Immediately upon completion of such service they would become members of a Combined Staff consisting of functional staffs of professional military officers in the fields of strategic planning, logistic planning, military requirements, and over-all military policy with a separate promotion system and accountable only to the Combined Staff, the Secretary of Defense, and the President.

Mr. Lovett also called for a thoroughgoing functional and organizational study of the three military departments, particularly the "technical services" organization in the Army.

The functions of these services, he charged, overlap in such matters as design, procurement, production, supply, distribution, warehousing, and issue.

Overlapping adds substantial complications to the difficult problem of administration and control.

"A reorganization of the technical services," Mr. Lovett stated frankly, "would be no more painful than backing into a buzz saw, but I believe that it is long overdue."

Industrial Atomic Power

American firms are using their own funds and pushing ahead with their own research on an atom power plant, according to Ray Cromley of the *Wall Street Journal* who interviewed outstanding scientific leaders during the 119th Annual Meeting of the American Association for the Advancement of Science which was held recently in St. Louis, Mo.

It would require about two years to build such a plant. The cost would be between ten and twenty million dollars.

As conceived by industrial scientists, the new facility would not be, at the outset, a complete power plant. It would only turn out the steam that could run a steam-power generator.

This partial power plant would be run experimentally for a year or more to eliminate inevitable defects. It would be rebuilt, where necessary, and improved. Next, a steam-power generator would be added. Then—say in about four years—this plant would be ready to turn out electric power for sale to private business and private industry in the vicinity.

According to present estimates the plant would probably produce 200,000 kilowatts of power.

This complete plant would strive to make a profit by selling a series of by-products as well as electric power. It might, for example, sell heat—probably steam at the source—for heating factories and office buildings. Again, it would probably try to sell plutonium (for making atom bombs) to the Government.

Another possibility would be to try to sell to Government and industry some of the other radioactive by-products produced when uranium atoms are split.

It seems likely that the first atom power plant would not make a profit. Furthermore, it would probably be dependent on heavy plutonium sales to the Government. And by the time it was operating, it would probably be obsolete.

In four or five years, however, the engineers and research men working on this power plant believe enough new information will be discovered so that they can make improvements.

These improvements, industrial scientists are convinced, will be great enough so that they can make a profit.

Of course, there are many political and scientific obstacles in the way of realizing this dream of a private-enterprise atomic power plant.

The Government would have to give permission, and Congress would have to change the atomic-energy laws quickly to permit a real start to be made by industrial firms or combinations of firms.

Scientifically speaking, there is now a lack of knowledge on how to "burn" all, or almost all, of the uranium fuel put into an atom power plant. Today only about one atom out of 140 is radioactive or immediately "burnable."

When scientists learn how to make all, or most, of the uranium atoms "burnable," then there would be a reasonable expectation of profitable operations—independent of supplying large amounts of plutonium to the Government at high prices.

Feathers for Clothing

A new, low-cost insulation material derived from chicken feathers has been developed experimentally by the Army Quartermaster Corps for use in making liners for cold-weather clothing. Jacket and trouser liners made with this material will be field-tested to check durability and behavior under conditions of actual wear. If such tests are successful, the insulation may ultimately replace wool as a liner for cold-weather Army clothing.

The new material is made of chicken-feather fibers to which a binding—a small percentage of natural or synthetic fibers—has been added. It is then fabricated into a stable batting which is quilted between two lightweight fabrics to form an extremely light and very warm liner.

The material is the product of research by the Quartermaster Corps, in coöperation with industry, for fibrous materials that can be used in the manufacture of low-weight, high-bulk clothing for cold-weather wear.

The Future of Defense Mobilization

An Editorial

"WELL begun is half done, but half done is not enough." This pithy observation might well be taken as the underlying theme of the Eighth Quarterly Report to the President (January 1, 1953) by the Director of Defense Mobilization, Henry W. Fowler.

We have made a good start. We have come a long way in the building of America's defense since the dark days of mid-1950. Our armed forces have been more than doubled. Our rate of production of military equipment has been multiplied almost seven times. Stockpiles of critical materials have been substantially increased in many instances. The basic industries which support military production have been expanded at a record rate.

Effective machinery to control the distribution of materials, until shortages have been overcome, has been created and is in good operating condition. Additional strength has been built also by our allies around the world, with substantial assistance from this Nation.

Program Only Half Completed

Yet with all these achievements our defense mobilization program is only in mid-passage. We still have a long way to go before we will have the military strength, the industrial readiness, and the assurance of continuing technological superiority that our national security demands. What, then, remains to be done?

The Office of Defense Mobilization offers the following 4-point program for our consideration:

I. We must complete the equipping of our expanded forces and provide the reserve stocks of weapons needed for our security.

Our military-force goal was set, one year ago, at 21 full-strength Army divisions, 143 Air Force wings, 400 Navy warships, 16 Navy carrier air groups, and 3 Marine divisions, with 3 air wings. Except for the Air Force (100 wings), almost all the planned units have now been formed. To provide supplies, equipment, and bases for these forces Congress appropriated $129 billion.

Of the procurement and construction already authorized, an estimated 37 per cent, or $48 billion, has been delivered to our forces. Much of the remaining 63 per cent, or $81 billion, is on order but is still in the various stages of production.

Thus the bulk of the weapons in the procurement program are still to be completed, even without taking account of the additional funds that will undoubtedly be made available. The task of overcoming lags in delivery dates, which recently have arisen primarily from design and engineering difficulties, and the problem of production planning of new models will be as urgent in the future as it has been during the months that have passed.

II. We must maintain our lead in military research and technology and continuously apply the results of our research to improving the equipment of our forces.

The build-up of our munitions industries has been in large part accomplished. But these industries must continually adapt their equipment and production methods to the requirements of new weapons, for each generation of weapons means a new program of development and production.

While we must meet the problems of obsolescence and change, we cannot put off adequate volume production of the best weapons available today because of the expectation that there will be better ones tomorrow. We must thus maintain a sound balance between sustained qualitative superiority and volume production because, in the present terrible competition, falling behind in either phase could spell destruction.

III. We must take systematic action to complete and maintain the mobilization base.

To complete the mobilization base means to identify the additional facilities, materials, and other elements of capacity that would be needed in the event of an all-out war and to take the necessary steps to assure that those which would constitute serious bottlenecks are provided for in advance.

Among specific mobilization-base programs are those aimed at expanding the supply of critical materials so that our strategic stockpile can be completed sooner. But new legislation is necessary to make possible the construction of certain types of productive capacity not needed for partial mobilization but necessary in the event of total war.

Adding new capacity can be futile, however, if existing capacity is at the same time dismantled or altered so as to make it unavailable for wartime production if needed. We are entering a period when the current requirements will have been met and production schedules will be reduced.

The loss to the mobilization base of needed facilities will become increasingly serious unless the Government adopts and carries out a firm program for maintaining in an adequate state of readiness those parts of the mobilization base which become idle.

IV. We must join with our allies, particularly the North Atlantic Treaty countries, in working out a satisfactory long-range basis for the common defense production effort.

Integration Will Reduce Burden

A well-integrated mobilization of all of the free world's resources will reduce the burden which each country, including our own, will have to carry separately. This becomes clear when we consider the NATO countries of Europe which have a highly skilled population of 200 million, a combined national product of $125 billion annually, and a great potential for further industrial growth. Mr. Fowler's 4-point program contains timely proposals which will carry forward to a logical conclusion the gigantic effort of the American people to maintain "a posture of defense."

ASSOCIATION AFFAIRS

• **EDWARD BEACH GALLAHER,** well-known industrialist and a life member of the American Ordnance Association, died at his home, Norwalk, Conn., January 9, 1953.

He was the author of the American Ordnance Association Letter, which he voluntarily wrote each month over a period of years. The Letter was sent to all A.O.A. members. He was also chairman of the Association's Committee on Abrasives and a director of the Association's Hartford-Springfield Post.

Born in Paris, France, of American parents and on American soil in 1873, Mr. Gallaher came of a long line of American leaders.

One of his ancestors was Elihu Yale, the founder of Yale University and governor of the East India Company at London.

His granfather, Moses Yale Beach, was an inventor, editor, proprietor of the *New York Sun*, and founder of the Pony Express.

His uncle, Alfred E. Beach, founded the *Scientific American*, edited it for fifty years, and, among other things, invented the Beach hydraulic tunneling shield.

Mr. Gallaher spent considerable time in France during his early years.

He was graduated from Stevens Institute of Technology, Hoboken, N. J., in 1894 with the degree of mechanical engineer. A few years ago his alma mater awarded him the honorary degree of doctor of engineering in recognition of his many achievements in the fields of engineering, manufacturing, and economics.

The American Society of Mechanical Engineers made him a Fellow in 1949.

Within a very few years after his graduation from college, Mr. Gallaher became known as one of the most energetic young engineers of the time. In 1896 he obtained the first prize in the national thesis competition sponsored by *Engineering News*.

He was a recognized expert in street railway engineering and construction, and was one of the earliest manufacturers of automobiles in the United States, making and selling the Keystone Motorette as early as 1897 and later the Searchmont.

During his long lifetime Mr. Gallaher took out a great many patents, particularly in the automotive field.

The Automobile Old Timers made Mr. Gallaher a life member for his pioneering activities and for the many "firsts" he established in the automotive industry.

Not only is he recognized as one of the earliest designers and manufacturers of motor cars, but he made the first trips by horseless carriage from Philadelphia to New York City and the first from Philadelphia to Baltimore and Washington.

Mr. Gallaher was a founder-member of the Automobile Club of America. He was the American delegate of the Motor Union of Great Britain, the Touring Clubs of France, Germany, and Switzerland.

In 1910 Mr. Gallaher moved to Norwalk, Conn., his idea being to devote the remainder of his life to scientific and economic research, subjects in which he maintained a deep interest throughout his lifetime.

However, the demand for a lapping compound, which he had first formulated in 1903 for use in his shops, became so persistent that he was virtually compelled to set up a small factory. This factory, which in the intervening years has grown under his guidance into the Clover Manufacturing Company, now makes lapping compounds and coated abrasives in a large Norwalk plant.

Mr. Gallaher was a member of the board of trustees of Stevens Institute of Technology and a member of the board of the Shriners Hospital for Crippled Children at Springfield, Mass. He was for many years the commodore of the Norwalk Yacht Club.

In October 1947, at its Twenty-ninth Annual Dinner Meeting at the Waldorf-Astoria, New York, the American Ordnance Association presented to Mr. Gallaher the Crowell Gold Medal for distinguished service.

As author of the American Ordnance Association Letter, Mr. Gallaher displayed his virile viewpoint concerning economic principles and his deep patriotic devotion to traditional American ideals. It is estimated that his A.O.A. Letter of February 1948, under the title of "Advice to a Young Man from an Older One," has gone through more than sixty editions of some three million copies. Copies are in constant demand.

His own philosophy of living is well expressed in the concluding lines of this Letter:

"If I had to pick out briefly the elements which make for success, I should place intelligence first, followed closely by knowledge—both general and special—acquired as you progress; strict integrity, modesty, sincerity; your ability to work with those around you, intense interest in your work which you must love, extreme faith in your own ability, faith in your fellow man, faith in our system of free enterprise, faith in our country which has given you the chance to live as a free man and prosper.

"And, last but not least, strong religious faith, which teaches that you must do unto others as you would that they should do unto you. With half the world steeped in atheism, our greatest need is sound religious faith—faith in God to whom we may turn for help and guidance. Alone we can do nothing.

"Good luck, my boy; fear no one; keep your chin up; rely on your own ability and hard work so that you may leave this world just a little better for your having lived, better for those who are to follow you. Never lose faith!"

• **DR. ROBERT W. CAIRNS and DR. LOUIS T. E. THOMPSON** have been appointed vice-chairmen of the Department of Defense Research and Development Board. Both distinguished citizens have been actively associated with the field of ordnance for many years.

Dr. Cairns, long a member of the American Ordnance Association, was formerly assistant director of research for the Hercules Powder Company, Wilmington, Del. He reported for duty with the Research and Development Board on January 14, 1953.

He has been associated with the Board since July 1949 as a member of the panel on ammunition and explosives of the Committee on Ordnance. Formerly chairman of the panel, he has recently been serving as alternate to the chairman.

In 1934 Dr. Cairns joined the Hercules Powder Company as a research chemist and has been with it since in various capacities. In May 1940, he was appointed assistant to the director of research, and from August 1941 until the beginning of 1945 he was director of the Hercules Experiment Station. Since that date he was assistant director of research.

An alumnus of the University of California, Oberlin College, and Johns Hopkins University, he was awarded a Ph. D. degree in physical chemistry by the latter institution in 1932.

During World War II, Dr. Cairns was a member of the Division of Explosives and a consultant to the Rocket Ordnance Division of the National Defense Research Committee of the Office of Scientific Research and Development.

More recently he has been serving on the advisory board of the Naval Ordnance Test Station, Inyokern, Calif., and the Bureau of Ordnance Research and Development Planning Council.

His work has been in the technology of high explosives and propellants; chemical engineering; cellulose, rosin, and terpene chemistry; and the industrial application of chemicals.

Dr. Cairns holds several patents in the explosives field and has published many articles in technical journals.

Dr. Thompson, vice-president of the Norden Laboratories Corporation, White Plains, N. Y., and Milford, Conn., was named as the second of two vice-chairmen of the Research and Development Board.

Dr. Thompson reported for duty on January 1, 1953. He recently completed a project for the Board in which he served as chairman of a group that made a study on aircraft rockets.

He has been in his present position with Norden Laboratories since October 1951.

During the years 1945 to 1951 he was technical director of the Navy's development and test center at Inyokern and Pasadena, Calif., when the Naval Ordnance Test Station was built and initially operated by the Bureau of Ordnance.

He was director of research and development of Carl L. Norden, Inc., and its subdivision, the Lukas-Harold Corporation, during the World War II years. Prior to that he was physicist at the Dahlgren Proving Ground, Va.

During World War II, Dr. Thompson was a consultant to the Manhattan Project from 1943 to 1946. From 1945 to 1946 he was a member of the Ballistics Research Committee of the Office of Scientific Research and Development.

He is at present a member of the Scientific Advisory Board of the Air Force, of the Advisory Board of the Naval Ordnance Test Station, and of the Technical Advisory Group for the Air Force Armament Center at Eglin Air Force Base, Fla.

Dr. Thompson is an alumnus of Kalamazoo College and Clark University. Among the groups with which he is affiliated are the Physical Society, the Institute of Mathematical Statistics, and the American Association for the Advancement of Science.

He is a specialist in ballistics and ordnance development and evaluation.

• **"LIFE MEMBERS OF THE AMERICAN ORDNANCE ASSOCIATION"** is the title of a new brochure recently published by the Association. Compiled as of December 1, 1952, the 16-page booklet was issued on January 1, 1953.

It cites the aims and purposes of the American Ordnance Association as set forth in the following by-laws:

1. To assist in effecting industrial preparedness on the part of a strong, private, free-enterprise system as being one of America's strongest guaranties of peace.

2. To encourage programs for ordnance research and development, particularly among private, industrial, educational, and research organizations in coöperation with the research agencies of the ordnance organizations of the Department of Defense and to keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance matériel.

3. To bring to the attention of the people of our country the necessity for scientific and industrial preparedness and through meetings, conferences, and publications to spread a proper understanding of the need for adequate ordnance and related military preparedness.

4. To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects and to encourage programs for the adequate understanding of the procurement, production, and other related phases of national preparedness, including those new developments of logistics necessitated by modern military strategy and tactics.

5. To encourage adequate military training throughout the Nation and the upbuilding of adequate enlisted and commissioned Reserves.

6. To promote mutual understanding and to effect coöperation among American scientists, inventors, engineers, and manufacturers in civil life and the personnel of the armed forces.

7. To coöperate with all agencies of the Government in planning mobilization and utilization of the Nation's scientific and industrial resources for the national security.

8. To assist in developing and maintaining efficient personnel, both commissioned and enlisted, for the units required for logistical support of the Army, Navy, and Air Force in the event of an emergency.

9. To commemorate the services rendered by the industry of the Nation and by the military personnel and civilian employees of the United States Army, Navy, and Air Force and of American science and industry in the wars in which the United States has been engaged.

Toward the perpetuation of the ideals expressed in the foregoing excerpts from the Association's by-laws, more than 33,000 American citizens are presently enrolled as active members. More than 800 are life members.

Life membership, as set forth in the Association's by-laws, is indicative of a continuing allegiance to the principles for which the organization stands.

In the new Roster of Life Members of the American Ordnance Association are inscribed the names, with city of residence, of all life members, including those who have been honored as American Ordnance Medalists. Also inscribed, in their accustomed place and with special affection, are the names of deceased life members.

A copy of the Roster of Life Members has been sent to each life member; copies will be sent to regular and associate members upon request.

• **AT WASHINGTON.**—Former President Truman paid well-deserved tribute to the Industrial College of the Armed Forces in an address to the Alumni Association of the college at Fort Lesley J.

NEWS OF A.O.A. TECHNICAL DIVISIONS AND COMMITTEES

In order that all members of the American Ordnance Association may be kept currently informed on the activities of the national Technical Divisions and Committees, a new feature will be added to the pages of the magazine beginning with the next issue (May-June).

Our special bulletin, INDUSTRIAL PREPAREDNESS, which is sent each month to members of our Divisions and Committees, will be incorporated, in the issuing months, in our bimonthly magazine, ORDNANCE. It is believed that this will soundly encourage the growing interest in the widespread voluntary advisory assistance which is thus being rendered by the Association to the national defense establishment—particularly the ordnance organizations of the Army and Navy, and the armament groups of the Air Force.

Suggestions of readers will be most welcome at all times. The work of our Technical Divisions and Committees is unique in the annals of our national defense, and we are most anxious to have it continue for the advancement of industrial preparedness.

LOUIS POLK
Vice-president for Technical Divisions and Committees, American Ordnance Association

McNair in Washington on December 16, 1952.

"The faculty and students of the Industrial College of the Armed Forces are doing a most important job," he said, "one that is altogether too little known and too little appreciated."

Mr. Truman cited the fact that over 17,000 students have taken short courses on economic mobilization given by the faculty of the college. More than 1,500 students have completed the correspondence course, and 2,300 are now enrolled.

"All this educational work needs to go ahead very rapidly," he declared, "if our country is to make the proper economic and military decisions and adjustments that will be needed to carry forward our work for peace."

Mr. Truman recalled that, in the first months after the Communist invasion of Korea, when nobody could be sure how close the Nation might be to a new world war, he launched the defense mobilization program.

"We laid out a program of rearmament on a scale beyond that which any free nation had ever accomplished in any period short of all-out war," he said. "We decided to add 2,000,000 men and women to our armed forces and to buy something like $150,000,000,000 worth of military supplies and equipment over a period of three or four years.

"We decided to carry out, in addition to the military production effort, a vast program of expansion of our basic industries, all across the economy. And we wanted to do this with as little interruption as possible in the normal and healthy growth of the standard of living of the country."

The military expansion, Mr. Truman stated, has not been quite as rapid as he had hoped. This was due to the magnitude of the program, the high targets that were set, the complexity of the new equipment, and to the overoptimism of procurement officers and producers in predicting how fast they could bring the new models of equipment into production.

Even though military production has not been as rapid as expected, the Nation has done much better than anticipated on the civilian side.

"During this period," Mr. Truman said, "we have expanded our basic industrial capacity at a greater rate than at any time in history—a rate of $27,000,000,000 a year. The gross national product, after adjusting for price changes, has gone up by $45,000,000,000, or 15 per cent.

"Over a period of three or four years, beginning with 1950, we will have increased our aluminum capacity by fifty per cent and even our steel industry by twenty per cent. We have twice as many aircraft plants in production as at the time of Korea and twice as many engine plants.

"I do not mean to imply that the defense mobilization program is over—far from it. We have just about completed the build-up of our munitions industries, but there is still over $100,000,000,000 in actual production to turn out. A lot of our newest models of equipment—guided missiles, for example, and supersonic aircraft—are still to be perfected for volume production."

Mr. Truman called special attention to the program of figuring out all the requirements for industrial capacity that the Nation would need in an all-out war—and preparing fully in advance to meet those requirements.

"What we call the mobilization base," he said, "has got to be complete next time, if and when a war starts, because we simply won't have time to build it after a war begins. If we had to hold up production for two or three years while we built long-lead-time machine tools, for example, that might very well be fatal. The specialized military production plants, and the stockpiles of materials, have to be ready. And once ready, they have to be kept ready."

Mr. Truman concluded his address by saying that "we have the resources to do whatever is necessary to protect and preserve our democracy and our freedom. And we have shown, over the past years, that we also have the courage and the will."

• **AT MIAMI BEACH.**—The first Regional Meeting of the year 1953 for members of the American Ordnance Association was held at the Indian Creek Golf Club, Miami Beach, Fla., on the afternoon and evening of February 16th.

There was a seminar in the afternoon, followed by a reception and dinner meeting in the evening.

The Florida Committee of the Post, under the joint chairmanship of George M. Corrigan and Col. Charles G. Mettler, acted as hosts. All members of the Association visiting Florida at the time were urged to attend. A large number of members and friends were present.

The seminar, beginning at four o'clock in the afternoon and lasting one hour, was under the auspicies of the Armament Test Center, United States Air Force, Eglin Air Force Base, Fla. Brig. Gen. E. P. Mechling, commanding, conducted the seminar which was devoted to discussions of aircraft armament progress in which the Technical Divisions and Committees of the American Ordnance Association are taking an important part.

The honor guest and principal speaker at the dinner meeting in the evening was Gen. Lemuel C. Shepherd, Jr., Commandant, United States Marine Corps. A reception in honor of General Shepherd was held at 6:30 o'clock. Dinner followed at 7:30 o'clock. The distinguished leader of the famed United States Marines delivered an inspiring address.

The Florida Post provided an excellent opportunity for members of the Association who were in Florida to greet General Shepherd, to consider armament progress, and at the same time to spend an afternoon and evening in the companionship of fellow members of America's leading peace organization—the American Ordnance Association.

• **AT HOUSTON.**—A general meeting of the Texas Post was held at the Ellington Air Force Base Officers' Club on December 2, 1952.

The results of a recent election of officers were as follows: W. O. Hedrick, president; W. H. Miner, vice-president; and Leo S. Bassett, secretary-treasurer.

The following directors were also elected: Philip P. Krumb, Sr., M. I. Kearns, Maj. R. D. Springer, D. J. Martin, O. L. Lorchn, and K. P. Campbell.

Friendship hour was held from 7:00 to 7:30 p.m. After an excellent dinner, the outgoing president, Brig. Gen. E. D. Konken, introduced the new officers and turned the meeting over to Mr. Hedrick, the newly elected president.

Mr. Hedrick introduced the principal speaker, Col. F. S. Bryan, deputy chief of the St. Louis Ordnance District, who took over his official duty in July 1952. Colonel Bryan came to the district well qualified, having served in the same capacity with the Pittsburgh Ordnance District since July 1951.

The 110 members of the Texas Post were given a splendid insight into the operations of the St. Louis District which covers 7½ States, with regional offices in Houston, Dallas, Tulsa, Denver, and Kansas City.

Upon concluding his remarks, Colonel Bryan opened the meeting to questions from Post members. All members were very well satisfied with the answers they received.

National officers associated with the Post are B. T. McNeil, a member of the national Advisory Board; Ross Stewart, a member of Council; and Daniel J. Martin, a vice-president of the Association.

• **AT DETROIT.**—The Ninth Annual Dinner Meeting of the Michigan Post was held at the Sheraton-Cadillac Hotel on the evening of December 17, 1952. Approximately 700 members of the Association, including many of the city's foremost industrial and business leaders, packed the grand ballroom of the hotel to enjoy an excellent program.

Outgoing President Robert L. Biggers gave a final report on the Post's business and social functions during 1952. He then introduced the following new officers for

the coming year: Henry T. Bodman, president; Charles L. Jacobson, first vice-president; Joseph S. Sherer, Jr., second vice-president; and Charles W. Brownell, secretary-treasurer.

One of the highlights of the proceedings was the honor paid to six veterans of World War II and Korea who are now undergoing treatment at the Veterans Hospital in Dearborn, Mich. Post members were delighted to have them as extra-special guests.

Irving A. Duffy, a director of the Post, was toastmaster. He introduced Brig. Gen. S. L. A. Marshall who paid special tribute to Capt. Lewis L. Millet for his brilliant work at Soam-Ni in Korea. General Marshall then introduced the principal speaker of the evening, Gen. John Reed Hodge, Chief of Army Field Forces.

General Hodge's extemporaneous remarks on how to fight world Communism were most attentively received by all Post members.

General Hodge, who commanded the XXIV Corps in Korea, advised Detroit industrial and business leaders that force is the one and only thing our Communist enemies will ever recognize, and that "delicacy" is just regarded as a sign of weakness on our part—yes, even an open invitation to attack our country and other free nations.

The general related his difficult dealings with the Reds in the complicated negotiations following World War II. He lauded Detroit industry for providing our fighting forces with the tools necessary to defend the country.

One of the most interesting parts of his talk, according to Post members, was the special emphasis he placed on the morale status of our soldiers, both in training and in action on the battle front.

Directors of the Michigan Post include Mr. Biggers, Mr. Bodman, Harold R. Boyer, Walter O. Briggs, Jr., Kenneth B. Coates, John S. Coleman, Mr. Duffy, Edward T. Gushée, Mr. Jacobson, Charles S. Mott, John W. Paynter, C. Jack Reese, George H. Roderick, John F. Gordon, and A. M. Wibel.

Mr. Coates is national Council representative.

Directors-elect for a 3-year term are William M. Day, James K. Fulks, J. S. Sherer, Jr., J. Thomas Smith, and F. Russell Valpey.

The chairman and vice-chairman of the Post Membership Committee are Mr. Fulks and William J. Athanason. Mr. Jacobson is chairman of the Activities Committee; chairman of the Outstate Chapter Development Committee is Mr. Roderick.

• **AT WASHINGTON.**—The January meeting of the Washington Post was held in the ballroom of the National Press Club on January 14, 1953.

Lieut. Gen. L. H. Campbell, Chief of Ordnance, United States Army, 1942-1946, recently elected president of the American Ordnance Association, was a special guest at the luncheon meeting.

The guest speaker was Jess Larson, General Services Administrator and Administrator of the Defense Materials Procurement Agency—two agencies which have important national defense procurement responsibilities. Mr. Larson reviewed the programs of these agencies and highlighted important future problems.

Future monthly luncheon meetings will be held, March through May, on the third Thursday of each of these months. Post officers are arranging interesting programs for these dates.

Ludlow King, president of the Washington Post, announced that the board of directors had made the following appointments: Fred T. Marshall, first vice-president, to fill the unexpired term of J. Donald Browne who resigned; T. J. McCloskey, second vice-president; and E. Willard Jensen, to the board of directors.

W. J. Sears is secretary-treasurer of the Post and the directors include C. E. Meissner, Brig. Gen. Merle H. Davis, Stanley A. Shank, George M. Riveire, W. G. Lockwood, Dr. A. V. Astin, Dr. A. F. MacConochie, C. H. M. Roberts, George E. Engelmann, Mr. McCloskey, H. N. Arbuthnot, and A. H. Hobelmann.

In his address Mr. Larson described how the General Services Administration had been handling its responsibility of procuring strategic materials for the stockpile. While appropriations for stockpiling pre-Korea were limited, the accumulation of strategic stocks was greatly accelerated as funds became available after the emergency was declared.

Noting that the Emergency Procurement Service had been made responsible for buying some seventy-four critical materials in the markets of the world, Mr. Larson said: "We can take great comfort in the position of the stockpile today—we are well beyond the halfway mark."

He mentioned with pride GSA's accomplishments as exclusive buyer of natural rubber in 1951, stating: "We were able to beat the price down from nearly $1.00 a pound to its present level of about 30 cents." He mentioned industry-government coöperation as an important factor in achieving the rubber stockpile target.

Present-day big government was described as posing the most difficult management problem in the world today. One reason for this is that government is unable because of the budget system to project its planning on a long-range basis in the same manner that private business and industry does.

Despite this, however, Mr. Larson said he felt important progress has been made in the techniques of government management. Creation of a common procurement agency was a significant "milestone in the science of public management." As now constituted the central procurement service provides a repository of knowledge on how to do business with the Federal Government, he stated.

It was Mr. Larson's belief that the Government will be in the raw materials stockpile picture for a long time to come. The need stems from the very growth and evolution of American industry which has so expanded its capacity to produce end products that it has outrun the supply of many of its most important raw materials. The problem of getting raw materials to the point of use will become an increasingly important responsibility of public management.

Mr. Larson also touched on defense expansion in his valedictory and asserted: "We cannot, should not, and, I trust, will not liquidate it when the fires die down."

He said he had seen demonstrated in his own experience as War Assets Administrator the wastefulness of disposing of facilities built at $27 billion for 20 cents on the dollar.

The present system of incentives was described as providing a better way of expanding production. Referring to World War II experience, he declared that the Government is not flexible enough and cannot plan far enough ahead to maintain production bases. Under the incentive system, plant expansion has been put largely in the hands of industry where forward planning is possible and which is capable of reserving this new capacity for us against time of need.

"If you are not already aware of it, let me state this matter of maintaining our production base is our No. 1 problem," Mr. Larson said.

• **AT NEW HAVEN.**—Formation of a general research organization for Olin Industries, Inc., was announced recently by Dr. Fred Olsen, vice-president for research and development and a life member of the American Ordnance Association. Dr. Olsen also named five department managers of the new general research organization.

Dr. Olsen, internationally known explosives chemist and inventor, and president of the Industrial Research Institute, said that the over-all research body will insure that Olin research will focus on developments of significance to the entire company.

The general research organization will conduct basic research and work with all eight Olin manufacturing divisions on specialized research problems and will coördinate the efforts of the company's various divisional research departments.

Among its various functions, the new research unit also will search for new products and processes, study current product lines to improve or expand them, and secure the best possible technical counsel, from within the company or outside, in the expansion of its work.

Laboratories already have been established at New Haven, Conn., and East Alton, Ill., staffed by a total of forty-five scientists.

Named as head of organic chemical research is Dr. Herman Bruson, one of the country's top polymer chemists and holder of 280 United States patents on chemical products and processes.

Melvin M. Johnson, Jr., inventor of the Johnson automatic rifle, has been associated with Olin since 1949 and is manager of armament research. Mr. Johnson has long been a member of the American Ordnance Association and a frequent contributor to this journal.

Hibben Ziesing, formerly Far East manager for American Cyanamid Company and chief of the Organic and Heavy Chemical Division of the Office of Price Stabilization during World War II, is head of petrochemical research. He joined Olin in 1952.

Dr. Robert L. Womer is manager of new products research. He previously was associate director for Olin's research and development activities. Dr. Womer has been with Olin since 1933 and is also a member of the A.O.A.

Dr. Oscar J. Swenson is manager of chemical engineering research. He holds significant patents in sugar-cane processing and has been a consulting chemical engineer after serving eight years as professor of chemical engineering at Cornell University. He is likewise a member of the Association.

Dr. Bruson came to Olin Industries from Industrial Rayon Corporation where he was manager of the polymer laboratory. Previously he was a research chemist with Rohm & Haas Company and with Goodyear Tire & Rubber Company. He received the Chicago Award as one of the ten outstanding organic industrial chemists in the country and was Priestly Lecturer in organic chemistry at Pennsylvania State College. His 280 U. S. patents cover the fields of plastics, resins, coating materials, bactericides, insecticides, petroleum additives, synthetic detergents, and industrial and organic chemicals.

Mr. Johnson, who heads armament research, received his law degree from Harvard, served on the law faculty at Boston University, and later maintained a private practice. He invented the famous Johnson automatic rifle while a gun enthusiast and Marine Corps Reservist during the 1930's. From 1938 until joining Olin, Mr. Johnson was president of Johnson Automatics, Inc., Johnson Patent Trust Company, Johnson Automatics Manufacturing Company, and Amoskeag Metals Products.

Mr. Ziesing, head of petrochemicals research, was graduated from Lawrenceville and Princeton. His background includes not only the Far East managership of American Cyanamid Company and the post of organic chemistry OPS chief during World War II but, most recently, sales responsibilities for Graselli Chemical Company.

Dr. Womer, manager of new products research, took his doctorate in 1933 at Washington University, St. Louis. With Olin he has been coördinator of explosives research, head of the commercial evaluation department, assistant technical director and associate director of research and development before advancing to his present post.

Dr. Swenson, new head of chemical engineering, was professor of chemical engineering at Cornell from 1938 to 1946 and then maintained his own organization as a consulting chemical engineer until joining Olin on December 15, 1952. He has been a technical consultant to Olin since 1945. Dr. Swenson holds nine patents and patent applications covering the recovery of sugar-cane wax from sugar-mill wastes, which serve as the basis for this new industry. He was graduated from the University of Minnesota as a chemical engineer in 1931 and received his doctorate in chemical and mechanical engineering in 1935 at Minnesota.

• **AT CAMBRIDGE.**—At a meeting of the Massachusetts Institute of Technology Post on December 4, 1952, the following officers were elected: Stanley A. Hoff, president; Ernest P. Abrahamson, II, vice-president; and Robert H. Tucker, secretary-treasurer.

Election of an executive committee was postponed until the next meeting. The Post has had a slow start this year but expects that interest and membership will increase from now on as the new program gets under way.

• **AT SAN FRANCISCO.**—At a recent meeting the San Francisco Post elected the following officers: B. C. Heacock, Caterpillar Tractor Company, president; Lawrence S. Fletcher, attorney, first vice-president; G. M. Greenwood, Rheem Manufacturing Company, second vice-president; and C. H. Wuerz, San Francisco Ordnance District, secretary-treasurer of the Post.

The following directors, in addition to the officers, were also elected: William H. Carr, California Packing Corporation; A. B. Layton, Crown Zellerbach Corporation; Elmer R. Peterson, Standard Oil Company of California; and D. A. Rhoades, Kaiser Aluminum & Chemical Corporation.

Other directors of the Post are: John E. Cushing, Oceanic Steamship Company; Edgar B. Jessup, Marchant Calculators, Inc.; Adm. George Murray (U.S.N., Ret.); Jean C. Witter, Dean Witter & Company.

The Post representative to the national A.O.A. Council is Dean Witter, Dean Witter & Company.

• **J. THOMPSON BROWN,** a director of E. I. du Pont de Nemours & Company and a charter member of the American Ordnance Association, died at his home in Wilmington, Del., January 31, 1953. An official of the Du Pont Company since 1903 he was closely connected with the powder and explosives programs of the armed services in the First and Second World Wars. Born in Baltimore, Md., Mr. Brown was a graduate of Virginia Polytechnic Institute.

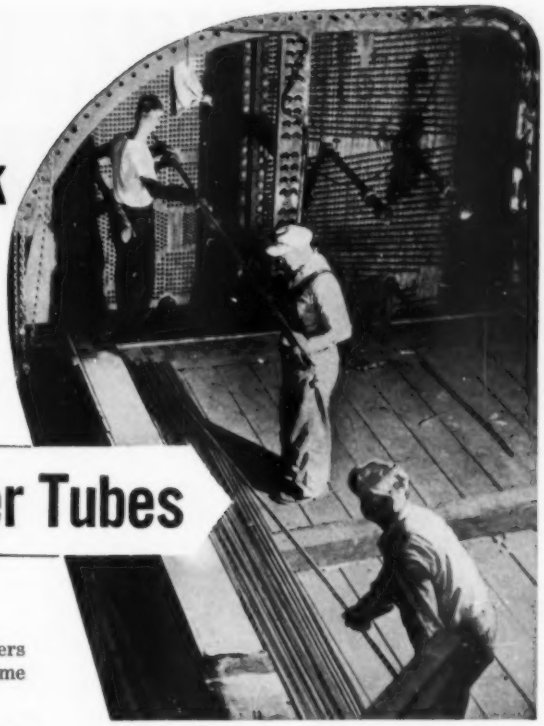
He was made manager of Du Pont's dynamite plants in 1915, becoming general manager of the explosives department in 1922. He had also served as a director of Remington Arms Company and Canadian Industries, Ltd.

The powder and explosives programs of the Ordnance Department of the Army were the special recipients of Mr. Brown's technical knowledge and experience. On behalf of his company he helped to make available the vast facilities and experience of that organization without which the record of Ordnance achievement in two World Wars would have been less noteworthy. He was especially helpful in keeping the Ordnance organizations of the Army and Navy alert to technical progress in powder and explosives production during the period between the two wars. His outstanding service to the national defense during these critical periods will be remembered with thanks.

• **H. M. A. HARTMANN,** chief mechanical engineer of the Magnetic Metals Company, Camden, N. J., died December 1, 1952. Associated with that company only a few months, he had previously served as mechanical engineer with the American Engineering Company of Philadelphia.

A native of Germany, he was educated there and received his early technical training in industries in that country. During his twenty-five years of residence in the United States, Mr. Hartmann was associated with the Edward G. Budd Company, Philadelphia, and the Alan Wood Steel Company, Conshohocken, Pa. He had been a valued member of the American Ordnance Association since the Second World War.

One Way to Lick Corrosion and Wear of Heat Exchanger Tubes



Anaconda 70-30 Cupro-Nickel Tubes, produced by AMERICAN BRASS COMPANY, Waterbury, Conn., were used to replace tubing of Admiralty Metal at the Harbor Steam Plant, Dept. of Water and Power, City of Los Angeles, Calif. View shows men retubing part of a 70,000 sq. ft. surface twin-condenser with 5,878 Anaconda cupro-nickel tubes ⅞" O.D. x 26' 3" long, serving a 75,000 KW turbine.

It takes a lot of handling to retube heat exchangers . . . and while the job goes on, equipment downtime plays mischief with production.

Minimize the risk of such shutdowns. Wherever heat-transfer capacity is a factor, especially where wall thickness of tubes allows but little tolerance for effects of corrosion and erosion, specify 70-30 cupro-nickel tubes.

Thin walls of this strong tough alloy resist corrosive and erosive attacks from all sorts of cooling media including polluted, silt-laden harbor water.

Along with ability to withstand a wide variety of corrosive agents, the 70-30 cupro-nickel tubing provides outstanding resistance to pitting and stress corrosion cracking.

* * *

Aship or ashore, this alloy gives unsurpassed performance in vital parts of equipment exposed to salt water corrosion.

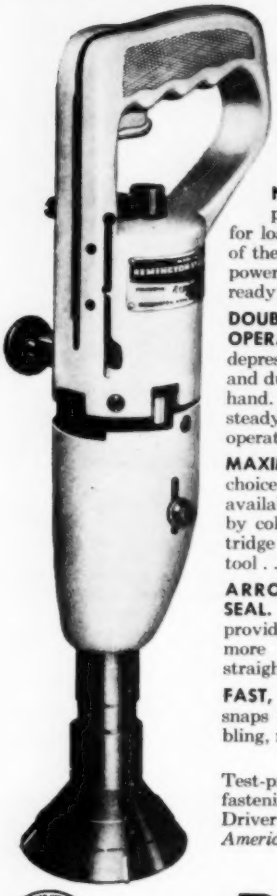
In power generator stations, sugar mills, oil refineries and similar plants . . . cupro-nickel alloys serve in feed water heaters, condensers, evaporators and other heat exchangers, and in oil coolers, stills, water boxes, piping, tanks, and other equipment. Cupro-nickel alloys minimize maintenance and replacement expense, loss of heat transfer capacity and interruptions of operation resulting from corrosion.

Cupro-nickel is produced in tubing, rod, strip, wire and sheet, and also in cast form. We shall be glad to give you additional information and help you select the one best suited to your requirements. Write us today.

At the present time, nickel is available for the production of cupro-nickel and other alloys containing nickel, for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

MODEL 450 REMINGTON STUD DRIVER



—the ONLY powder-actuated fastening tool with ALL these advantages—

NO ACCESSORIES REQUIRED. No separate parts needed to control power, none required for loading—nothing to lose or break. Just a twist of the wrist opens the Model 450. Insert stud and power cartridge as a unit . . . close and you're ready! Whole job takes seconds.

DOUBLE-SAFE—REQUIRES *BOTH* HANDS FOR OPERATION. A separate safety lever must be depressed and *held* that way with one hand before and during squeezing of the trigger with the other hand. Safe, two-handed operation holds the tool steady. Two *additional* safety devices prevent operation except in proper fastening position.

MAXIMUM POWER RANGE. You get a wide choice of power in Remington cartridges. They're available in six different loads, each clearly marked by colored plastic heel caps. The 32 caliber cartridge gives you extra power in this medium-duty tool . . . helps you speed all types of fastening jobs.

ARROW-STRAIGHT DRIVING—PERFECT GAS SEAL. Long heel cap on all Remington cartridges provides tight gas seal . . . gives the Model 450 more power. Assures controlled, consistently straight driving.

FAST, POSITIVE EJECTION. Exclusive ejector snaps fired case out of tool instantly—no fumbling, no tools needed.

* * *

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., *America's oldest sporting arms manufacturer.*

"If It's Remington—It's Right!"

Remington DU PONT

Listed & Approved by Underwriters' Laboratories, Inc.

NEW, FREE BOOKLET shows you a hundred different ways the Model 450 Remington Stud Driver can speed *your* construction fastening. Packed with illustrations, it tells you where and how this tool can save time, reduce fatigue and cut costs. Send in the coupon for your copy.

—MAIL THIS COUPON TODAY—

Industrial Sales Division, Dept. O-3
Remington Arms Company, Inc.
939 Barnum Ave., Bridgeport 2, Connecticut

Please send me my free copy of the new booklet showing how I can cut my fastening costs.

Name .....

Position .....

Firm .....

Address .....

City ..... State .....

NEW DEVELOPMENTS

SUPERSONIC WIND TUNNEL

Aberdeen Proving Ground will get a new supersonic wind tunnel this year, capable of producing air velocities equivalent to 3,700 miles an hour. It replaces the tunnel shipped recently to the Redstone Arsenal, Huntsville, Ala.

This supersonic tunnel, now being constructed in Quincy, Mass., by the Shipbuilding Division of Bethlehem Steel Corporation, will incorporate the latest engineering and aerodynamic features known. The tunnel will have a 13-inch by 15-inch test chamber and will be of the flexible-nozzle type which permits testing at velocities between one and five times the speed of sound.

OPERATION FRUIT FLY

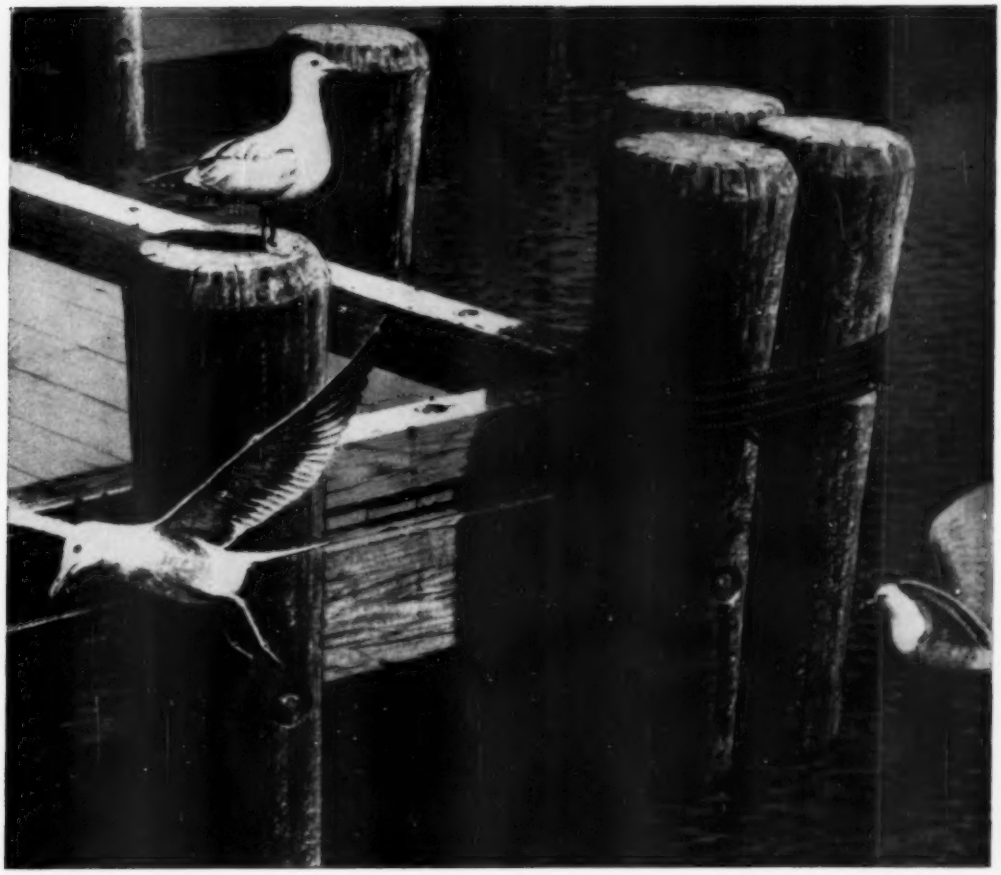
An upper-air research project, in which fruit flies will be used to obtain data on the effects of cosmic radiation at very high altitudes, has been announced by the United States Air Force.

This research will be carried out as an additional phase of the Air Research and Development Command's previously announced balloon research project, which seeks data on the state of winds, temperatures, atmospheric pressures, turbulence, and types of cloud formations at altitudes between 50,000 and 100,000 feet.

Controlled balloons launched from West Coast sites will carry, in addition to their recording instruments, pressurized test tubes containing harmless fruit flies (*Drosophilia*), similar to those sometimes seen on bananas. The balloons will be launched when the prevailing winds are from the west, so that they will travel over and come down in the United States.

The success of the project depends heavily on prompt action by the public in returning to the Air Force the equipment containing the fruit flies. These containers will be marked plainly with complete instructions to the finders regarding their return to the U. S. Air Force. With the returned fruit flies, the Air Force will carry on genetical studies to determine the biological effect of cosmic radiation on the mutation rate and will compare these mutations, if there are any, with those caused by radiation such as X-ray, neutron, and gamma.

Previous high-altitude research flights by the armed forces have enabled man to measure the quantity of cosmic radiation at various altitudes. The present tests will be the first of a series of experiments which, it is hoped, will aid in dispelling all fears of possible aftereffects from radiation on pilots of current and future high-altitude aircraft. *(Continued on p. 818)*



The hungriest worms in the world

You don't often catch a glimpse of them. They live and eat under water . . . in places like the one in the picture. But they have the most enormous appetites you ever heard of.

These hungry worms are marine borers . . . Giant Pileworms. Some grow as big as 6 feet long. They bore relentlessly into piles and other submerged timbers. They eat the wood away. Honeycomb it with holes. Make it collapse.

But Koppers has a way to make water worms lose their appetites. By pressure-treating timbers with creosote, Koppers helps keep dock piles and other marine installations safe from marine borers. Heavy creosote content keeps them away.

Various pressure-treatments by Koppers can also make wood resistant to decay, to termites, to fire, to acid.

Maybe there's a Koppers Pressure-Treated Wood that will help *you* to solve some wood service problem. Why not write to Koppers Company, Inc., Wood Preserving Division, Pittsburgh 19, Pa. We welcome your inquiries.

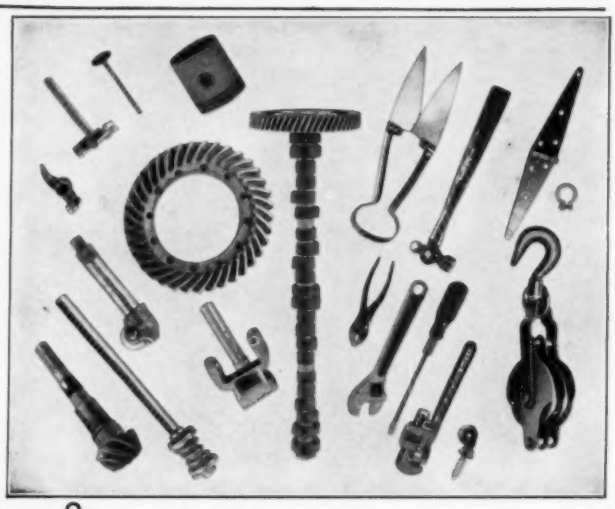
KOPPERS

PRESSURE-TREATED WOOD

THE PRESSURE-TREATMENT of wood is just one way in which Koppers serves industry and you. Koppers also produces chemicals from coal. It manufactures flexible couplings, roofing, paving materials, industrial piston rings, fans, and protective coatings. It designs and builds most of America's coke ovens. There are many Koppers products or services that will help your business.

AMERICAN CHEMICAL PAINT COMPANY
AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: RUST PROOFING WITH PERMADINE®



Steel parts that have been Permadized and then "sealed" with a rust-preventive oil such as "Granoleum" are effectively protected from rust. And, if the oiled "Permadine" coating should be damaged, rusting will not spread beyond the area of exposure.

Note: Automotive and other rubbing parts subject to friction are usually given "Thermoil-Granodine" manganese-iron phosphate coatings for both wear-resistance and protection from corrosion.

DATA ON THE "PERMADINE" COATING	
Type of coating	Zinc phosphate
Object of coating	Rust and corrosion prevention
Typical products treated	Nuts, bolts, screws, hardware items, tools, guns, cartridge clips, fire control instruments, metallic belt links, steel aircraft parts, certain steel projectiles and many other components
Government Specifications	U.S.A. 57-0-2C, Type II, Class B MIL-C-16232, Type II U.S.A. 51-70-1, Finish 22.02, Class B AN-F-20 Navy Aeronautical M-364 JAN-L-548
Scale of production	Large or small volume; large or small work
Method of application	Dip Barrel tumbling, racked or basketed work
Equipment notes	Immersion tanks of suitable capacity. Cleaning and rinsing stages can be of mild steel. Coating stage can be of heavy mild steel or stainless steel.
Chemicals required	"Permadine" No. 1
Pre-cleaning methods	Any common degreasing method can be used. Alkali cleaning ("Ridosol"), Acid cleaning ("Deoxidine"), Emulsion-alkali cleaning ("Ridosol" - "Ridoline"); vapor degreasing, solvent wiping, etc., are examples. Acid cleaning may need to follow other cleaning methods if rust or scale is present.
Bath Temperature	190° - 205°F.
Coating time	20 - 40 minutes
Coating weight range	1000 - 4000 mgs. per sq. ft.
Technical Service Data Sheets	No. 7-20-1-2 T.M. No. 5

CHEMICALS ACP PROCESSES WRITE FOR FURTHER INFORMATION ON "PERMADINE" AND YOUR OWN METAL PROTECTION PROBLEMS CHEMICALS ACP PROCESSES

New Developments

The research balloons, which are from 45 to 110 feet in diameter, have been sent aloft by the Air Force since June 1951. They are tracked by ground direction-finding stations throughout their flights. When the balloons descend to 30,000 feet they are automatically destroyed, and the recording equipment is parachuted to the ground.

HYDRAULIC COMPRESSOR

A new type automatic hydraulic compressor, capable of compressing gas to 100,000 pounds per square inch, has been installed by the Navy. Purpose of the device, one of two in existence, is to facilitate study of the behavior of fuels at gun pressure. Unique features of the device are an automatic hydraulic control and driving system and the use of "liquid" pistons. Besides being more compact, efficient, and flexible, hydraulic drive avoids mechanical systems composed of gears, cranks, and shafts, such as would ordinarily be used to drive reciprocating pumps. It is a product of the Harwood Engineering Company, Walpole, Mass.

HIGH-VACUUM FURNACE

A new high-vacuum melting furnace affording larger charges of purer alloys than previously possible has been installed at the Naval Ordnance Laboratory, White Oak, Md. The furnace will take charges of about 30 and 100 pounds and can take a charge of 200 pounds of ferrous materials, melting them in a vacuum of about 1,001 millimeters of mercury. With power supplied by a 50-kilowatt, 3,000-cycle motor generator the metal is heated by a high-frequency coil.

PRECISION OSCILLATOR

As part of a program devoted to the improvement of measuring and calibrating standards, the National Bureau of Standards has developed a crystal oscillator that is small, portable, dependable, and accurate over long periods of time. The new oscillator unit, developed by Peter G. Sulzer of the NBS staff, utilizes a junction transistor as the source of driving power for a high-stability quartz crystal unit. All components of the circuit, including the power supply, fit into a metal tube less than two inches in diameter and about seven inches long. At an operating frequency of 100 kc. the long-period drift in the first model was about 3 parts in 10^9 per day.

MODIFICATION PLANT

A new tank modification plant being built at Newark, Del., at a cost of $3,100,000, will be operated by the Chrysler Corporation and will employ 400 persons. It will become an integral part of the Chrysler Delaware Tank

It's a double load

Today's semi-military economy makes it necessary for American industry to double up on production—to supply the needs of our armed forces as well as industrial and civilian requirements.

To help further this double-barreled program, American Locomotive has *two separate* production schedules.

For example, one Alco plant is busy turning out modern diesel engines to serve in pumping stations on pipe lines carrying oil for essential military and civilian needs. At another Alco plant, the Army's new medium tanks are being made by Alco's Ordnance Division with the assistance of a network of 2,000 subcontractors.

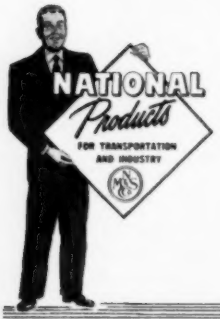
Other American Locomotive divisions are producing equipment for essential transportation, chemical, petroleum and power industries, with separate facilities devoting their efforts to defense. *Both* lines of production help keep America strong and secure.

AMERICAN LOCOMOTIVE COMPANY

producing both industrial and defense products

Castings by National

selected for Quality and Dependability

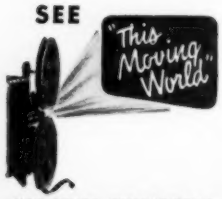


Products bearing these familiar trademarks have all established enviable reputations for quality and dependability. And to guard product reputations, these manufacturers *continue* to specify castings by National —one of the Nation's largest founders.

National's unparalleled experience in producing malleable, heat-treated malleable, and steel castings is at your disposal. Sales offices and engineering facilities are located at all five strategically located plants.

A-5065

PLANTS LOCATED IN Sharon, Pa., Cleveland 6, Ohio, Indianapolis 6, Ind., Melrose Park, Ill., and Chicago 50, Ill.



A 16mm technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings.

NATIONAL
Products
FOR TRANSPORTATION AND INDUSTRY

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY
CLEVELAND 6, OHIO
Est. 1868

New Developments

Plant. The Army anticipates that it will be in initial operation by April 1, 1953, and in full operation by July 1st.

The new plant will be used for making final installation of on-vehicle equipment and any modifications which may be required on all tanks produced in the Delaware Tank Plant. The new facility also will be used to prepare tanks for shipment in such condition as to be ready for immediate use in the field.

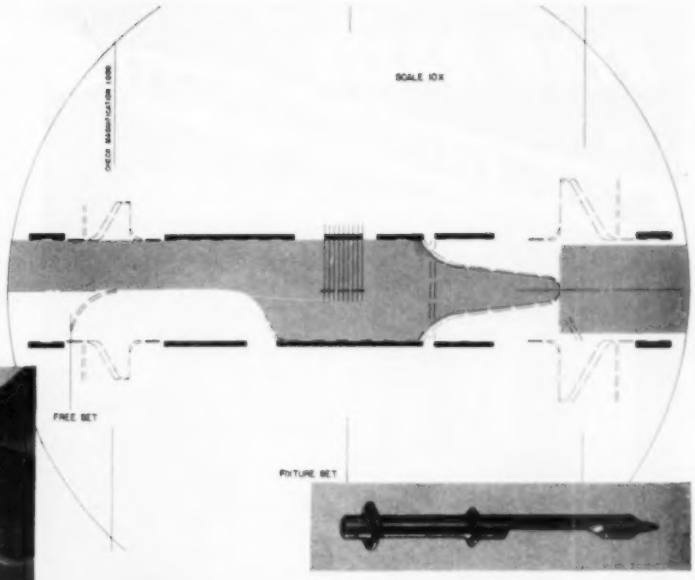
RETREADS FOR TANKS

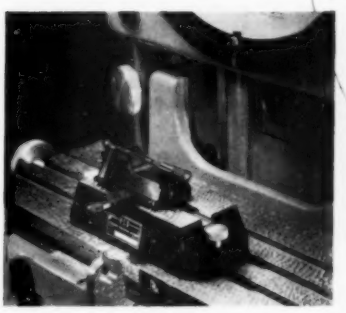
The Detroit Arsenal recently completed a pilot plant for reconditioning and retreading tank road wheels and tracks. It is estimated that operation of this plant and others like it will save the American taxpayer more than $6,000,000 each year. The life expectancy of new road wheels and tracks is approximately 2,500 miles. In the past it has been necessary to discard equipment that had traveled this distance because the wheels were so worn and warped during this period that they could not be resurfaced with rubber. There were no molds available flexible enough to absorb the irregularities of the used wheels.

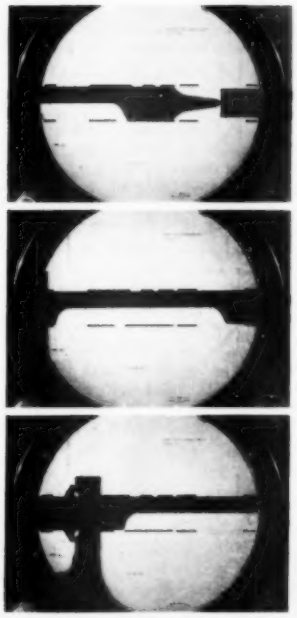
Heat hardening flange of a tank wheel.

At the same time the guide flange on the used road wheels was found to be so worn as to render the wheel unsatisfactory for continued service. A special rapid welding and machining process was developed to overcome this difficulty. New guide flanges are built up by dropping molten metal on the prepared wheel surface, then machining to the required size. It is estimated that during times of emergency annual savings will amount to $27,000,000 and more than 28,000 tons of steel. Supply problems will be greatly simplified, and it will not be necessary to maintain depot stocks at their present level. Facilities currently used for shipping and storing road wheels will be available for other equipment. *(Continued on p. 822)*

The heavy lines on the Chart-Gage have indentations forming slits of light when the part is within tolerance. If the part is undersized, light is seen under the entire line. If oversized, no light is seen. Only a quick glance is necessary to check tolerances. Experienced help is not required.







The above photographs show the image of the part in the three inspection positions. The same "composite" Chart-Gage is used for all three.

26 DIMENSIONS...

checked in 60 seconds

The firing pin illustrated above has 26 critical dimensions. Yet, by Optical Projection Gaging, the entire inspection takes less than 60 seconds—a fraction of the time and costs required with mechanical gages.

The part is mounted in a fixture on the stage of a Kodak Contour Projector. Its image, magnified 10 times, is projected on the screen and compared with a Chart-Gage. Although the image of the 3½″ part is 35″ in length, the entire part is checked on the 14″ diameter screen by means of indexing the part in the fixture. The entire procedure requires less time than it would take to merely handle the gages ordinarily used.

Perhaps you can realize similar savings in inspection costs through Optical Projection Gaging, as so many industries and government facilities have. To find out, send sample parts and specification prints for our analysis, or write and have our local representative contact you for a personal conference.

OPTICAL GAGING PRODUCTS INC.

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Ryan Industries of Detroit supplies USAF with rate of climb indicators which must meet rigid test specifications under conditions of high altitude and extreme temperatures.

Standard Bowser test units perform this all-important testing job for Ryan. Indicators are tested at temperatures from −67°F. to +160°F., at altitudes varying from sea level to 50,000 feet.

Rapid pull down time after each test run enables Ryan to deliver ***more*** of these vital instruments to USAF . . . each pre-tested under accurate flight conditions.

Why don't you take advantage of long ***continuous*** experience? Consult Bowser, the pioneer.

PROGRESS REPORT . . . Three more high altitude Walk-In test chambers are currently under construction in Bowser's enlarged plant.

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TECHNICAL REFRIGERATION
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Send information on test equipment checked:

☐ High Temperature	☐ Fungus Resistance
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☐ Walk-In Rooms	☐ Vapor Tight

☐ Special Engineering 1-5

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New Developments

CASTINGS FOR MISSILES

Guided missiles open a wide new field for castings, Brig. Gen. William T. Hefley told the American Foundrymen's Society recently at the organization's meeting in Columbus, Ohio. General Hefley, who is assistant for matériel program coördination at the Air Matériel Command, said castings, being "the cheapest method of fabrication known," will provide a cheap disposable container for guided missiles.

Since the missile is a one-shot weapon, he said we must keep its cost to a bare minimum and concentrate necessary expenditure upon the vital elements of the warhead and guidance mechanism. "For quantity production we will be shopping for the cheapest disposable container that will do the job. Everything points to the foundry industry as the logical place to get it."

UNDERGROUND STORAGE

Facilities for underground storage of more than 2 million barrels of liquefied petroleum gas have been built in the past two years, and capacity for 5.9 million barrels will be available by the end of 1953, according to a survey by the Petroleum Administration for Defense. About five-sixths of the underground storage capacity will be close to producing areas of the Southwest, with a number of smaller projects located in marketing areas of the Middle West.

Cavities for storing liquid petroleum gas are generally constructed by hydraulic mining in salt domes or layers, or by shaft mining in sandstone, limestone, or similar formations. These facilities are cheaper than pressure tanks built above ground, and require less steel.

PRESS INFORMATION

A new booklet on hydraulic presses and processes of special interest to Ordnance personnel has recently been released by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. The booklet presents technical shell-forging, shell-testing, shell-nosing, cartridge-case forming, and cold-extrusion processes in an interesting manner readily understood by the layman. It also contains information on gun-barrel straightening and armor-plate production.

"HOMEMADE" GRENADE

A "homemade" concussion grenade designed by Sgt. First Class George W. Kingsley of Peoria, Ill., has been so successful in combat that a front-line shop has been set up in Korea to produce them. Sergeant Kingsley went to work on his project after he heard several men wishing for a more effective concussion grenade. The standard cylinder-type missiles often failed to explode and some-

● The "third degree" is but a superficial scanning compared to the trials a ball bearing must withstand in New Departure's Research Laboratory. Here, under conditions which pack years of normal use into a short time, engineers determine how to make the best ball bearings even better.

Production bearings and experimental designs, alike, take this "torture treatment." They are subjected to overspeeds and overloads, intense heat and cold, day and night operation for protracted periods.

Search and Research

Three decades of this search and research have produced the sealed rear wheel-bearing for motor cars, the self-sealed bearing for farm implement use, the tiny, jewel-like bearing for delicate instruments . . . and many other types to fit a host of applications.

You can specify New Departures and *know* that they are right for the job. Keep your eye on the BALL to be sure of your BEARINGS!

Vibration analyzer eliminates human error in scientific search for causes of noise in bearings.

New Departure ball bearings are readily available at your equipment dealer or bearing distributor —supplied from the industry's largest network of warehouse stocks.

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BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Also Makers of the Famous New Departure Coaster Brake

Rockwell Report

by **W. F. ROCKWELL, JR.**
President
Rockwell Manufacturing Company

OUR COMPANY HAS BEEN MENTIONED in management magazines as a case study in manufacturing decentralization. Not so often mentioned is the fact that our sales management is rather highly decentralized, too, with many similar results in efficiency.

In the first place we have four major independent selling organizations . . . one for valves, meters and related equipment; one for utility valves; another for transportation registers and the other for power tools and equipment closely allied to power tool distribution.

Within each of those organizations, management responsibility rests very largely in Regional Sales Managers, and under them, District Sales Managers. These field sales managers have the authority to make many decisions on the spot, saving time and money. They eliminate the necessity of an unwieldy headquarters sales management staff to clear piles of reports. And best of all, they learn to accept management responsibility, giving us another source for top staff men when needed.

* * *

The second fastest growing industry in America today, according to authoritative statements, is liquefied petroleum gas. Without the fanfare and glamour of, for instance, the television industry, liquefied petroleum gas is growing by jumps, bringing to rural and fast-growing suburban areas the same conveniences people in cities have come to take for granted.

Propane and butane, the fuels of the LPG industry, are used in cooking, heating, refrigeration and for other uses. Our part in this mushrooming industry is the manufacture of LPG liquid and gas meters. With Rockwell meters LPG users pay for their fuel in the same way as their city cousins—in exact relation to the amount they use.

* * *

One of the best testimonials to the safety features of our Delta power tools is the record of the Wisconsin School for the Visually Handicapped, Janesville, Wisconsin. Here, blind students are taught woodworking on Delta tools by Frederick Hoyer, a blind instructor. This is his report:

"*At the beginning, the Bureau for Handicapped Children which supervises this school was not sure that blind pupils could be safeguarded from possible accidents. To convince them, I installed a Delta circular saw in my garage workshop. Demonstrations of my own operation of this tool convinced my associates that blind pupils could be taught to use Delta Power Tools with safety.*

"*So in 1928 the school bought its own Delta tools . . . a circular saw, drill press, belt sander, jointer and lathe. We have never added an extra safety device to any of our Delta tools and in all the years these machines have been used, no pupil has suffered an injury that required medical attention.*"

* * *

In an earlier item in this column we mentioned that we were involved in a suit to sustain one of our power tool patents. When one company brought out a design that we felt infringed our patent, a Federal court upheld us. When another company did the same thing, a second Federal court held that the device was so simple it lacked inventive merit, in spite of the fact that several companies had worked for years to develop such a device without success.

The implications of a case like this are sometimes lost in the technicalities of patent law. While we are fighting the case, a great many other companies and inventors are affected by the outcome. The questions are basic: first, when many people fail at a development but one succeeds, isn't that evidence per se of inventive merit; second, if there are to be different standards for determining patentability in different Federal courts, under what rules are we working?

One of a series of informal reports on the operations and growth of the

ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.

for its customers, suppliers, employees, stockholders, and other friends

New Developments

times rolled back to the men who threw them uphill.

After two days of study, Sergeant Kingsley solved the problem. Taking a half-pound block of TNT, he cut a groove in one end and inserted a standard hand-grenade fuze. He then wired two small strips of wood in the form of a cross to prevent the block from rolling. Sergeant Kingsley's battalion commander has approved the grenade and has authorized its use in all of his companies.

NEW BRITISH AIRCRAFT

The new all-jet Royal Air Force is being built around eight "superpriority" planes. Britain's commercial airlines will concentrate on three main types of jets.

There are now eleven turbojet or turboprop planes being manufactured in Britain —eight warplanes and three civil airliners. As they come off the production lines in greater quantity, these will by degrees replace piston-engined aircraft.

The majority of the new models are strikingly futuristic in design, with swept-back or delta-shaped wings and high-rising tails. Long spearlike protuberances jut from the noses of the fighters, giving them a swordfishlike look. These are the "probes" for refueling in flight.

The delta-winged Avro-698 4-jet bomber, the Vulcan, is revolutionary in shape. Powered by Rolls Royce Avon axial-flow turbojet engines, this huge fan-shaped plane with the long nose is capable of carrying a great bomb load at speeds approaching that of sound.

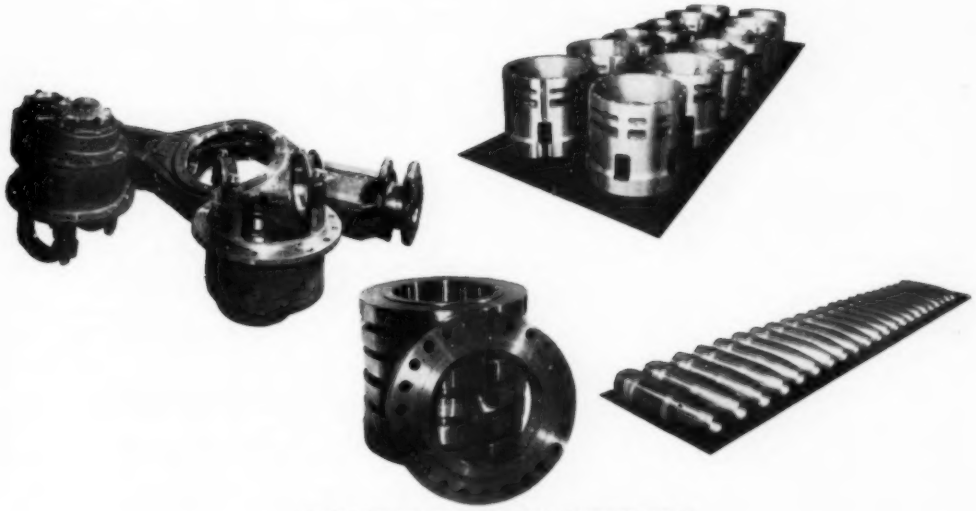
Latest of Britain's heavy bombers to be ordered is the crescent-winged Handley Page 80, the "Victor." This is powered by four Sapphire jet engines that provide more thrust than twenty-five modern express locomotives.

This aircraft also flies at around 600 miles an hour—close to the speed of sound. Its unusual wing shape—which, after sweeping back sharply, thins and curves out again toward the tip at right angles to the line of flight—has been designed to give it greater maneuverability and stability at lower speeds.

Third superpriority bomber is the Vickers Valiant, which also has a swept-back thin-bladed wing and four turbojet Rolls Royce Avon engines. This, too, is designed for long-range strategic operations and has a very heavy bomb-load capacity.

The sole medium bomber on superpriority production is the twin-jet English Electric Canberra, now being used in Britain as a trainer. First such plane to feature a side-by-side seating arrangement for pupil and instructor, it also has space for a navigator. The Canberra is already in service with the R.A.F. and is

Another Example of Beaird Manufacturing Skill



PRODUCTION MACHINING

The Beaird machining division is tooled up for a high rate of production. One entire department is now turning out large orders of ordnance shells; another is manufacturing a full line of cast steel refinery fittings. Other machined products include parts for heavy duty trucks, oil field equipment and army tanks.

THIRTY-FIVE YEARS EXPERIENCE in manufacturing a wide variety of products have made Beaird unusually well equipped to handle large production orders of ordnance materials.

Central location near Southwest ports
Ample supply of Skilled labor
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A MOISTURE AND ABRASION-PROOF PROTECTIVE COATING FOR METALLIC AND OTHER SURFACES

SPRAYS ON

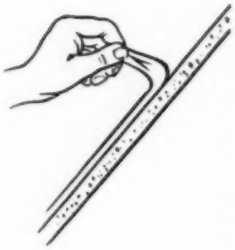
A moisture and abrasion-proof protective coating for metallic parts and surfaces — ideal for packaging tools, gears, bearings, instruments and parts while in process, transit or storage.

SPRAY-STRIP is resistant to salt water, moisture, oils, grease, mildew and alkalies. It will not support combustion after application, and will remain flexible at low temperatures.

STRIPS OFF

Fast drying, Spray-Strip forms a smooth, tough skin which protects surfaces against damage caused by moisture, scratches and abrasion. May be peeled away in large sections or a single sheet depending upon thickness of application.

May also be used to coat walls of storage and curing rooms to aid humidity control and for spray booths and other surfaces subject to soil.



Technical data on request

EAGLE CHEMICAL COMPANY

146 INDUSTRY AVE., JOLIET, ILLINOIS

said to be the fastest medium bomber in the world.

The three superpriority fighters are the single-jet Swift and Hunter and the double-engined Javelin. All have a radically advanced look. The Swift and the Hunter have their wings sharply swept back. The Javelin has a delta-shaped wing and a high-rising tail. All are capable of near-sonic or supersonic speeds. It is estimated that these are so advanced in design they will not be outmoded for a considerable time to come.

Last of the fighters on the list is the navy Fairey Gannet—a double Mamba turboprop machine designed for action from aircraft carriers against submarines. It has been reported to have a retractable radar bubble, sonobuoys, and the latest sub-hunting equipment.

Considerably more details are available about the three superpriority civilian planes—the 130-ton Bristol Britannia; the Vickers Viscount, most modern medium-sized airliner in operation; and the De Havilland 4-jet Comet, with its 500 m.p.h. cruising speed.

Largest of the three is the Britannia, with a maximum seating capacity of nearly 100, accommodation for 3 tons of freight, a range of 5,600 miles, and a wing span of 140 feet. The Britannia's propellers are 16 feet in diameter. The aircraft is powered by 4 Bristol Proteus turboprop engines, each developing a thrust of 3,780 horsepower.

20,000-TON PRESS

The Aluminum Company of America recently was awarded a contract for a 20,000-ton extrusion press under a lease arrangement with the U. S. Air Force. The 20,000-ton press, in addition to a 14,000-ton press now being installed as part of the same program, will produce king-size extruded shapes for military and civilian aircraft. Wide, ribbed shapes for integrally stiffened wing panels and heavy shapes for spar caps will be the speciality items on the press, but in time of peace it also will be capable of producing wide thin shapes for building curtain-wall construction as well as large size pipe for the chemical and petroleum industries.

To relieve internal strains in the shapes and to straighten them after extrusion Alcoa already has scheduled installation of a 3,000,000-pound stretcher. It will straighten shapes up to sixty square inches in cross-sectional area in one of the strongest aircraft alloys, 75S. Maximum weight for extruded shapes from the 20,000-ton press will be 2¼ tons. Maximum length for heat-treated shapes will be set by existing heat-treating equipment at ninety feet. The new press will be able to extrude ingots eighteen to forty-one

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adaptability, flexibility *and* **durability** *of*

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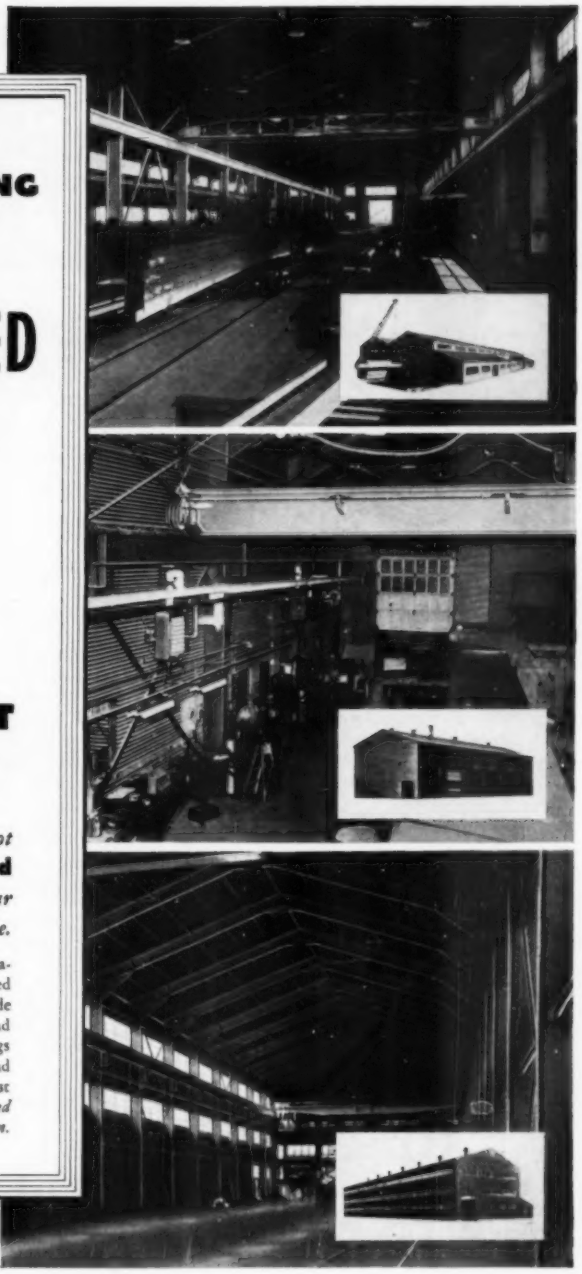
To achieve utmost *durability of structure*, the materials and construction of Luria Standardized Buildings meet the *most stringent* building code requirements. And because of their *flexibility* and *adaptability of design*, Luria Standardized Buildings make possible almost any type of structure and almost any type of architectural treatment that best suit *your* particular requirements. *This is accomplished without sacrificing the economics of standardization.*



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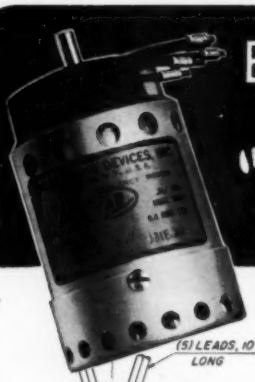
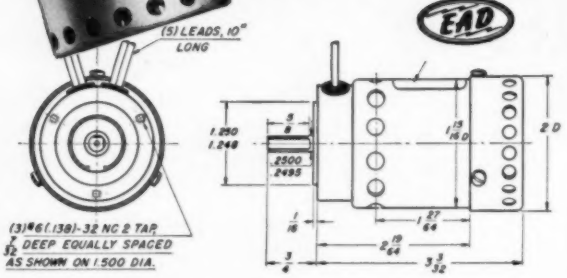


EAD ENGINEERING gives you "2 for 1"

MODEL J31E-23

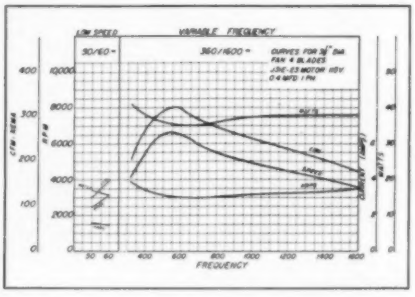


Here, designed into one small frame, is a variable frequency capacitor motor capable of operating at dual frequency ranges of 50/60 cycles or 360/1600 cycles. Another oustanding EAD engineering achievement . . . one motor that does the work of two!

SPECIFICATIONS

Continuous duty • single phase • 115 volts AC • Ambient temperatures: −55°C to +85°C • Weight: 1 lb., 1 oz. • Meets military specifications for humidity, salt, shock, vibration and tropicalization.

Applications: Airborne equipment (fans, blowers, pumps and other suitable uses.)



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If your problem involves rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or designs and produce a special unit to meet your most exacting requirements.

EASTERN AIR DEVICES, INC.

585 DEAN STREET, BROOKLYN 17, NEW YORK

inches in diameter and nearly eight feet in length.

HUMIDITY INDICATOR

A new type of humidity indicator, designed for use in the dehydrated packaging of military materials and other products which must be kept in storage safe from moisture damage, has been announced by

Bull's-eye humidity indicator.

the Davison Chemical Corporation, Baltimore, Md. Known as a "bull's-eye" and intended to be assembled as an integral part of the container itself, it is already in use in the packaging of certain of the currently produced missiles.

The new device is equipped with gaskets and metal fittings which permit it to be fastened to a nipple welded to the shell of the container or package. A tight seal against moisture infiltration is thus provided. The bull's-eye is of glass and contains a silica gel which changes color from deep blue to light pink as it picks up moisture. The air within the container can circulate freely through the indicating gel and thus an easy visual means is provided for determining humidity conditions within the package without opening it.

VERSATILE FUZE OIL

A diester oil containing an oxidation and rust inhibitor has been developed by the Army Ordnance Corps' Pitman-Dunn Laboratories, Frankford Arsenal, Philadelphia, Pa., which permits operability of a mechanical time fuze at temperatures from 65 degrees below zero Fahrenheit to 160 degrees above.

Firing tests in a 90-mm. antiaircraft gun with stored lubricated fuzes have indicated that this diester lubricant is far superior to the previously recommended porpoise-jaw oil at temperatures of the order of minus 65 degrees Fahrenheit. At room ambient, or slightly higher temperatures, however, both the diester and porpoise-jaw oil are satisfactory for the efficient functioning of equipment.

In the production of this oil by commercial suppliers, great difficulties were encountered in the preparation of an effective rust inhibitor. The Pitman-Dunn Laboratories have developed a method by which a reproducible and acceptable barium petroleum sulfonate rust inhibitor can be made. This method has been forwarded to all interested fuze-oil suppliers and, as a result, the necessary quantities

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are at the disposal of all who plan and purchase for National Defense. From this one centralized source of engineered products and engineering services the Armed Forces can order a portable radio mast or contract for a complete ordnance plant or air base. Due to the wide range of industries we serve and products we make, Blaw-Knox is staffed with hundreds of technicians whose engineering skills run the gamut of the profession. If this experience plus our manufacturing facilities can assist your efforts, just "say the word."

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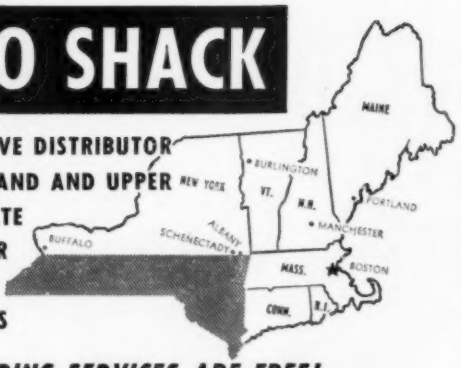

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. . . for the ultimate in data recording

- FLUTTER and WOW: less than 0.1% *peak-to-peak*. Error on final data less than 0.7% using ±7.5% deviation.
- FREQUENCY RESPONSE: within 3 db. from 200 to 80,000 cycles at 60 ips, or 200 to 40,000 cycles at 30 ips.
- SIGNAL-TO-NOISE RATIO: well above 40 db. at the 1% harmonic distortion level, measured in 15% bandwidths.
- FOUR CHANNELS: three for data recording, one for timing reference. All chassis of plug-in construction.
- Meets all relevant JAN specifications and Navy Department Specification 16-E-4.

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of fuze oil required for the current production program are now available.

VIKING REDESIGNED

A completely redesigned and reengineered Viking high-altitude rocket, one of a series built by the Glenn L. Martin Company for the Naval Research Laboratory, equaled the previous single-stage altitude mark of 135.6 miles when launched on December 15, 1952, at the White Sands Proving Ground, Las Cruces, N. Mex. Shorter by some six feet and of slightly greater diameter, with completely new control, fuel, and electronics systems, Viking No. 9's most readily distinguishable external feature was smaller, triangular fins. The power plant, made by Reaction Motors, Inc., was of the same type used on previous Vikings, using liquid oxygen and alcohol, with a thrust of 20,000 pounds. In addition to the usual telemetering equipment Viking No. 9 carried six cameras, photon counters, and photographic film detectors.

ORDNANCE EXCHANGE

Savings to the taxpayer of many thousands of dollars, plus greatly reduced "deadline" time for Army Ordnance equipment will result from a newly instituted "direct-exchange" system at the Armored Center, Fort Knox, Ky. Under the plan, now in use in Korea, all a motor or supply sergeant must do to get a replacement for a defective part is to exchange it at Armored Center Ordnance for a part that works.

Col. John M. Henderson, Jr., Armored Center Ordnance Officer, said that identification cards have been issued to those personnel whose duties require the turn-in and receipt of parts. The cards, issued by the individual unit commander, are a check to see that no abuses of the system, or of Army property, take place.

CERAMIC AIRCRAFT BRAKE

Aircraft brake lining using one of man's oldest materials, fired clay, to withstand the enormous heat generated in braking heavy, high-speed jets and transports is now in production by Bendix Aviation Corporation.

The new lining, a ceramic-based compound including other highly heat-stable elements, was developed after years of research in the problem of devising a friction surface able to survive aircraft landing impacts which heat brakes to as high as 1,800 degrees in three seconds. Increases in brake energy ratings on the order of fifty per cent and service life approximately five times as great as with the best conventional linings are made possible by the new development, it is claimed.

Typical of modern jet-plane braking requirements is the need for a design to

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★★★★★ **for light or heavy products...**

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there's a General engineered shipping container to meet military packing needs!

Pictured here is a General Wirebound box for the export shipment of 50-caliber ammunition. It combines strength and light weight. It is one of many types made by General —to meet military needs. Remember General when you have a military packaging problem. Container experts will be glad to design a package for your product, or help you with various specifications.

Write for your FREE *Copy of "The General Box." It shows how to cut packing and shipping costs.*

DISTRICT OFFICES AND PLANTS: Cincinnati, Denville, N. J., Detroit, East St. Louis, Kansas City, Louisville, Milwaukee, Sheboygan, Winchendon, General Box Company of Mississippi, Meridian, Miss., Continental Box Company, Inc., Houston, Dallas

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CANNON PLUGS *to* **ARMY ORDNANCE** *specification*

AO Cannon Type AO Series connectors are manufactured under the latest specification pertaining to electrical systems for military vehicles and associated external electrical equipment. "AO" connectors will mate with standard "AN" fittings. Are ideal for heavy duty industrial use.

This new series is designed to withstand extreme conditions of temperature, moisture, dust, vibration and shock. Shell material is aluminum alloy with natural iridite finish. Insulators are of a special molded resilient material having high dielectric strength, medium oil resistance and will not support combustion. Resilient grommet provides moisture proofing over solder terminals.

For engineering data, request Bulletin AO-1952.

SOCKET INSERT ASSEMBLY TYPE AO-RA00 WITH GROMMET RETAINING NUT

TYPE AO-PA06 WITH GROMMET RETAINING NUT

SOCKET INSERT ASSEMBLY TYPE AO-RB02

PIN INSERT ASSEMBLY TYPE AO-RB02

AO TRAILER RECEPTACLE

DUST CAP

AO SLAVE RECEPTACLE

TYPE AO-22 ANGLE 90° ELBOW

WRITE FOR BULLETIN AO-1952

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New Developments

stop 17 tons of plane in 20 seconds from a ground speed of 135 miles an hour. The new lining was developed to control such momentum within wheel and brake size limitations which applied to World War II aircraft weighing seven tons and landing at ninety miles an hour. Now available for commercial aircraft, the new development will meet airline needs for brakes working at extremely high temperatures where long service life is demanded.

X-RAY IMAGE AMPLIFIER

Radiologists and physicians now have a new tool in the X-ray image amplifier—a device that will give them a 200 times brighter view of their patient's internal organs in living action. An attachment for standard fluoroscopic equipment, the image amplifier is now going into production at the Westinghouse X-ray Division in Baltimore, Md., after eight years of intensive research. Basically, the amplifier consists of a high-vacuum tube that electrostatically focuses and accelerates an electron stream.

OLD AMMUNITION RECLAIMED

The Ordnance Ammunition Center of the U. S. Army at Joliet, Ill., has purchased General Electric mouth-annealing equipment for installation at eight locations throughout the country in a dollar-saving program of reclaiming old ammunition of 40-, 75-, 76-, and 90-mm. calibers.

The purpose of the program is to reload shells that have become unreliable because of age. To reclaim the outdated shells, the projectiles and powder are removed from the cartridge cases and the mouth of the brass casing softened by induction annealing. This insures a snug fit against the grooves of the projectile when the cartridge cases are refilled.

HIGH-SPEED TURBOPROP

Airplane speeds well above that of sound are promised with a new turboprop engine and special propellers developed by the Curtiss-Wright Corporation, Woodridge, N. J. The combination will eventually permit speeds up to 1,000 miles an hour, it is claimed.

NEW RESEARCH CAMERA

Based on the action of a mirror which rotates at a speed of 50,000 revolutions a minute and wipes an image onto film at a sweep rate of 5.466 millimeters per microsecond, a new research camera has been developed by Beckman & Whitley, Inc., San Carlos, Calif. Belonging to the general classification often referred to as "smear" or "streak" cameras, this instrument is designed for the study of self-luminous transient events such as explosive, flash-tube, and spark-discharge phenomena.

CONCEPTION TO COMPLETION

In the field of Guided Missiles an engineering team which can carry a program forward from the very conception of the idea to the completion of a missiles weapon system is essential. Such a team is at work in Fairchild's Guided Missiles Division. Supporting this experienced engineering team is a production organization which has produced complete missile weapon systems for all three branches of the Armed Services. Recently Fairchild completed this country's first privately built plant devoted exclusively to missile design, development and production.

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Guided Missiles Division

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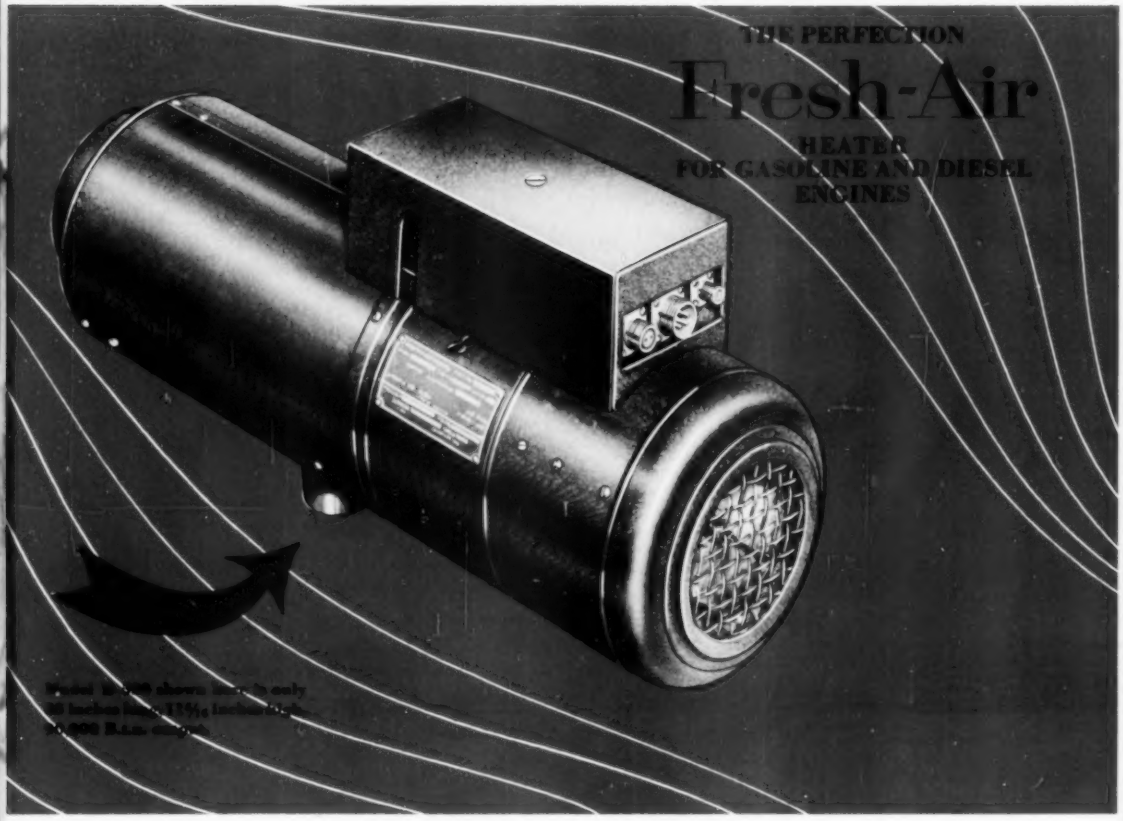

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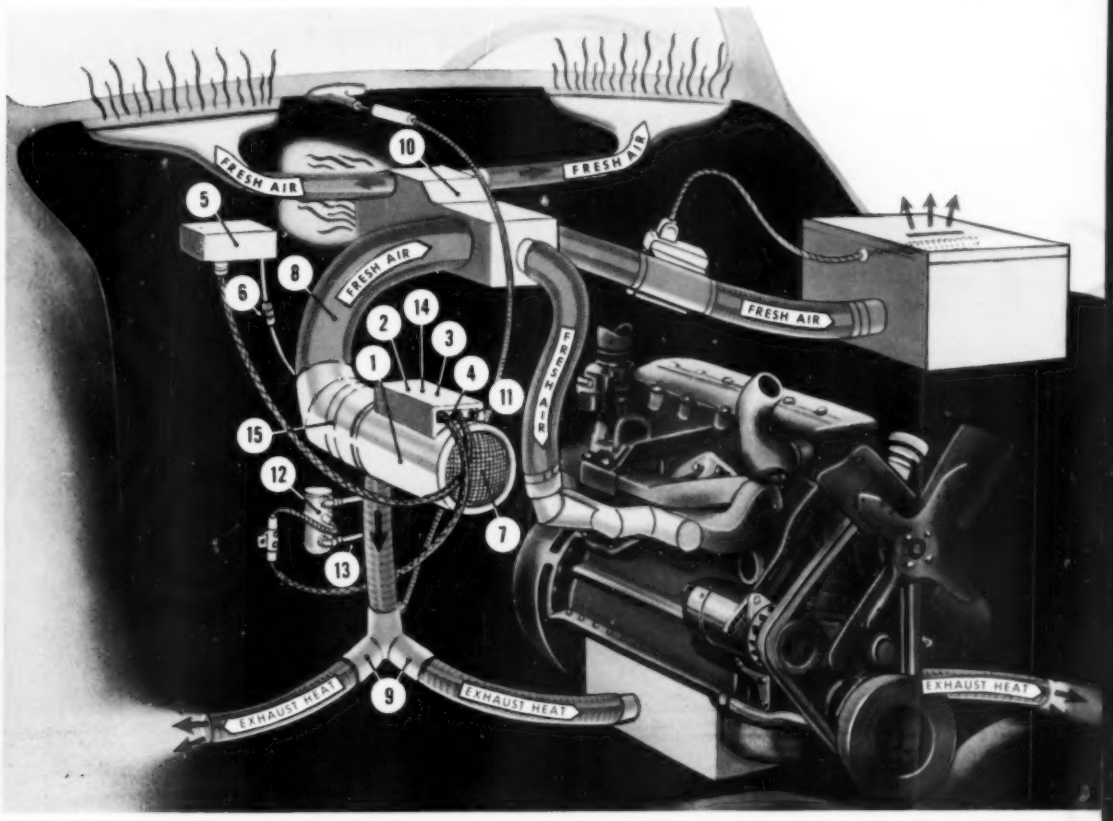

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4. Positive Electric Starting – Dependable Perfection Glow Plug provides positive ignition. Perfection Fuel Timer shuts off fuel supply, eliminates flooding in case of fuel or battery failure.

5. Remote Control – ONE switch, mounted where *you* want it. Manual, semi-automatic or fully-automatic operation.

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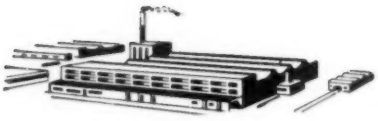

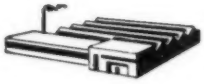

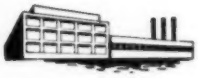

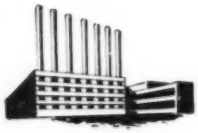

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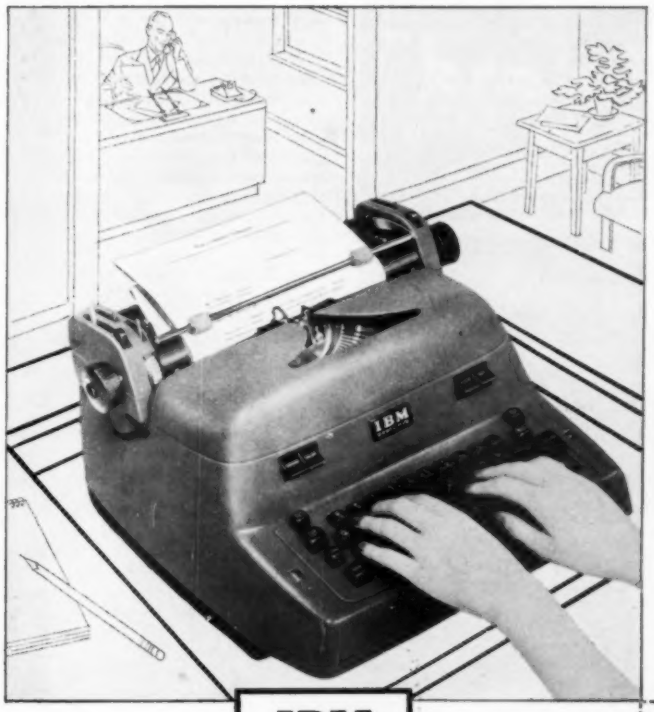

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FROM THE RECORD

THE CHALLENGE OF DEFENSE

K. T. KELLER
Director of Guided Missiles, Department of Defense

Once having arrived at reasonable evidence that an idea for a weapon is a workable one, we face the job of designing it for manufacture and making ready to produce it. This may be done even though it still is necessary for the using services to evaluate such things as its reliability, how well the men can be trained to use it, and its behavior under many conditions so that a commander may work it into war tactics and depend on its accomplishing the mission set for it.

But building our defenses is a lot more than making weapons. Weapons themselves are only one end product of a national effort which may make greater demands upon industry than any civilian endeavor. Because defense may require the complete strength of our country, we cannot, at this time of partial mobilization, allow ourselves the luxury of lost motion, needless duplication of effort, and uncoördinated waste of our energies and resources. What we waste now may be vitally needed later.

Thus every effort must be made to maintain intelligent coördination between the fighting services and the industry which serves their needs. This coördination must be tight to insure that our research and development of new weapons is always in the forefront and that those who fight get the best weapons we can invent and produce.

Further, we must have the best possible liaison between industry and the Government in the research and development of weapons of major importance. Such liaison must have continuity through all related agencies of Government, industry, and the users of the weapons. This liaison, moreover, should see that the special skills and talents in the sciences, which are in the hands of those whose normal business best qualifies them to do the job, are fully brought to bear on the problems.

Finally, research, development, and production facilities for defense must be located physically in those places where people are at hand who can provide the skills and manpower needed to operate them. When emergency expansion of pilot and stand-by facilities must take place, it can then occur with a minimum of shifting of people and without totally disrupting the lives of thousands who may be involved.

Modern warfare, or even defense preparation in a semimobilized state, is an

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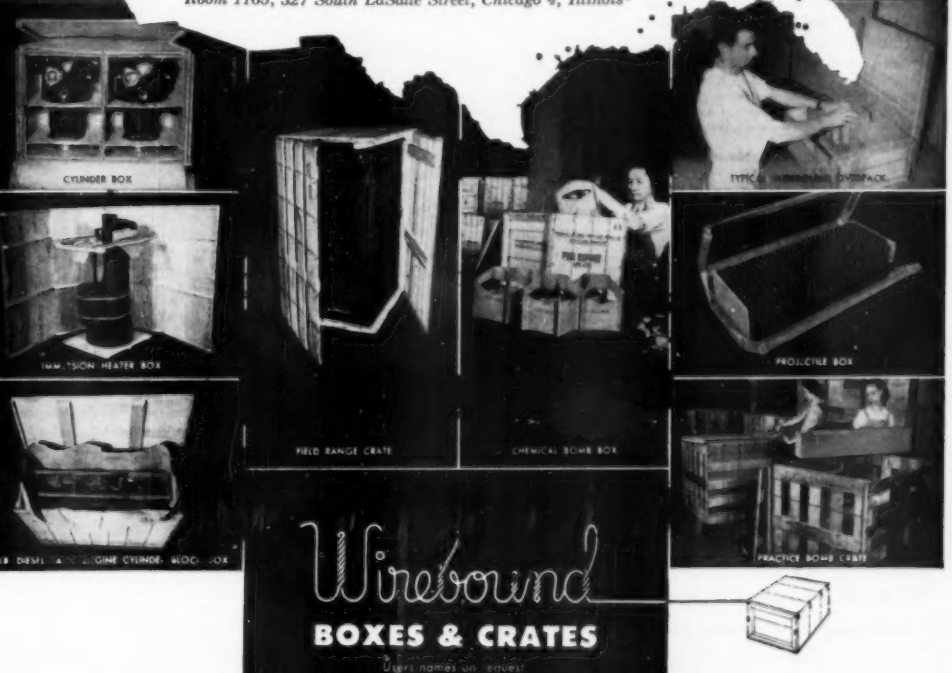

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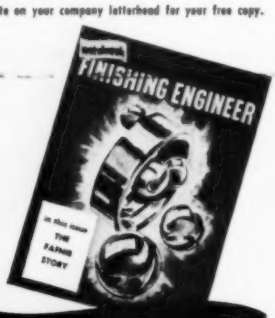

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From the Record

undertaking that challenges the best efforts of a modern society. The risks we face are so great and the stakes involved are so high that we cannot do less than conduct our preparations to prevent war with all the careful coördination and efficiency it is in our power to command.—*From an address at the Industrial Award Banquet of the Society of Industrial Realtors, Miami Beach, Fla.*

THE AGE OF TECHNOLOGY

HENRY B. DU PONT
Vice-president, E. I. du Pont de Nemours & Company

Productive technology is one of the greatest developments of the modern age. It has been both the engineer of change and the social scientist of reform. It has created material comforts and conveniences beyond the wildest dreams of a century ago. It has lifted the burdens which once bound men to the soil and made them old before their time. It has opened new opportunities of leisure and cultural development to millions.

But the great paradox of the twentieth century is that, despite this progress, we still find ourselves uneasy, dissatisfied, uncertain of the future. We have found a peace that is not peaceful, a security that is not secure. We face grave and difficult problems in many parts of the world. We have large debts and a heavy burden of taxation. To defend ourselves we must maintain a large military establishment, with the sacrifice that entails disruption of lives and careers.

Many reasons are advanced for this unhappy state. Some attribute it to a spiritual breakdown, to preoccupation with material ends. Some feel that the rate of technological progress has been too rapid —that the race was bred for centuries to perform hard manual labor and has not yet accustomed itself to tending machines and setting thermostats. Some lay the fault to capital, some to labor, some to government.

Perhaps some or all of these viewpoints have a degree of merit. But underlying each of them is a basic and very real misunderstanding—misunderstanding of the rôle of technology in modern life. And because of this misunderstanding there is suspicion and fear—fear of the machine, fear of change, fear that a few large corporations could, through their technology, dominate our whole economy.

These fears and conflicts arise directly from our technological progress. In the days when we had mainly an agricultural economy, a man could see and depend on the results of his own labor. The same was true of our early artisans, owning their own simple tools. But today the tools of industry are so complex and expensive that no one man can furnish the funds to provide them or supply the many specialized skills and talents necessary for their operation.

In our company, for example, the investment works out to something like $18,000 per employee, and the plant in which he works may cost as much as $100,000,000. We have 140,000 stockholders, and we employ hundreds of different types of specialists and technicians. So today the worker is dependent for his well-being on the coöperative efforts of many people whom he seldom sees and doesn't know—and is therefore likely to misunderstand and distrust.

Today we see evidences of this lack of understanding, this fear, in all parts of the world. We say that Communism is the greatest peril to our own security. But Communism is literally an expression of this same fear; for Karl Marx saw, mistakenly, in the machines which created the Industrial Revolution, a threat to the livelihood of the people.

Modern followers of Marx should know better, for events have proved their prophet the worst forecaster in history. But the fears and the misunderstandings still persist.

They persist in the attitude of those labor groups which profess to believe that less output per man will somehow produce an economic benefit. The resistance of the British trade unions to mechanization of the coal mines is a ready example, one which helped reduce the powerful United Kingdom to its present one-egg-a-week routine.

The facts of life in the field of technology are little understood—particularly the ways in which modern technical processes are brought into being and their products made available to the public. Technology can benefit no one when it remains in a vacuum.

A technical development may have its beginning in a laboratory, perhaps a college laboratory. But it will benefit mankind only when it serves some useful purpose. This requires a financial risk to build the facilities that will produce on a scale large enough to achieve low cost and wide distribution. Thus in this country the fruits of technological progress reach the public through the medium of American industry.

So when we say American technology we are saying American industry—the two are almost synonymous. To praise technology and condemn industry—and there are those who manage to perform this odd twist of logic—is like favoring education but condemning the university.

Fears and misunderstanding of technology are reflected today in many government attitudes toward industrial development. This is particularly true in such areas as the antitrust field and in tax legislation. There is a tendency to re-

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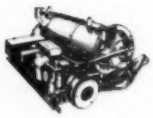

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CAN MARKEM HELP YOU? Printing labels directly on cartridge enclosed fuses is but an example of how Markem solves industry's marking problems. Markem has been providing industry with production techniques and equipment to identify, decorate or designate its products, parts and packages since 1911. Markem also provides technically trained men who are available in your area to assure *continued* satisfaction with Markem methods and equipment.

When *you* have a marking problem, tell us about it and send a sample of the item to be marked. Perhaps a complete Markem method has *already* been developed to solve your problem. If not, Markem will work out a practical solution.

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MARKEM ...TO MAKE YOUR MARK

From the Record

gard bigness with distrust, regardless of the fact that much of today's technology requires huge resources of capital and organization . . .

There have been times in the past when fears were expressed that widespread unemployment would result from technological advances. But today few are deluded by the myth that technology will make displaced persons of our industrial population. If the buggy whip and the livery stable have become extinct, they cannot be mourned by a society that employs 12,000,000 people to make and service the automobile. Today, after the most intensive technological program in history, we have the largest employment force in history.

Yet occasionally there have been those who actually called for a moratorium on research and invention. You will recall that such outcries were popular during the 'thirties. But let us suppose that all research and development had somehow been halted arbitrarily at some given point in history. Without tractors and machinery and chemical fertilizers our farms could not have supported our growing population, and soon we would have stagnated into a nation of paupers and peasants, like India or China . . .

A hundred years ago, the average American workman had a few simple hand tools, and for power he was limited to his own muscles, plus the help of domestic animals and water wheels. He worked from the time he was through with his elementary schooling until he died. Assuming that he survived for the Biblical threescore years and ten, he probably spent a total of 56 years on the job, 72 hours a week, 52 weeks a year. Add this up, it comes to something like 180,500 hours of his life.

The average workman today, with modern machinery and equipment, probably works from the age of 19 to the age of 65, or 46 years. He works only forty hours a week and has at least two weeks vacation. When you total this, you find he works over his productive life less than 90,000 hours—or about half of the time put in by the 1852 worker, and he performs his duties in greater ease, safety, and comfort.

The reason, of course, is advancing technology. It has been estimated that every horsepower of mechanical or electrical or chemical energy put at his disposal multiplied his own efforts twenty-two times. He doesn't work shorter hours because some benevolent law permits it. He works less hours only because with modern machinery he can outproduce his grandfather many times over.—*From an address before a divisional meeting of the Association of Land-Grant Colleges, Washington, D. C.*

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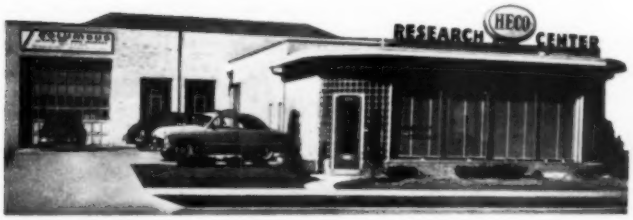

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BRIG. GEN. THOMAS K. VINCENT, *artillerist, engineer, author, Redstone Arsenal, Huntsville, Ala.*

Midcentury Journey. By William L. Shirer. New York: Farrar, Straus & Young. 310 pp. $3.50.

IN this nostalgic and unpretentious chronicle, the author of "Berlin Diary" revisits the Europe he first saw in 1925. He wanted to do two things: to find out where we stood at the midcentury mark and to review the history of the past quarter of a century in order to gain some perspective and some bit of understanding regarding our present difficulties.

Much of the book is a digest of European history from the end of World War I to the present. Although a competent journalistic performance, one is left with the feeling that Mr. Shirer did not have to go all the way to Europe to tell again the sad, familiar story; he could have written the book in the New York Public Library.

He found the Viennese, having survived three decades of horror, still managing to make life livable. The French, as usual, are pessimistic. Germany, with the help of its conquerors, is getting back on its feet. There will always be an England, of course, but the majesty of empire, the splendor, glory, power, and solid wealth of yesterday are lost forever.

That's about all, except that Mr. Shirer becomes really excited about the climate of intolerance, fear, and hysteria he found, upon his return, in his native land. His final verdict, however, is that we should feel proud and glad to be living at this tumultuous time in so great an age.—JOHN J. O'CONNOR.

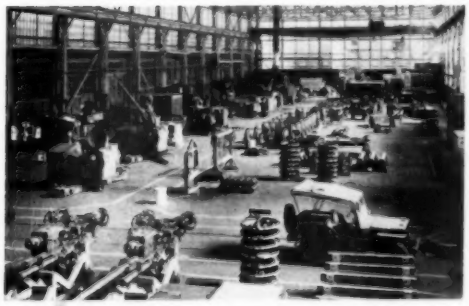
The World of Eli Whitney. By Jeannette Mirsky and Allan Nevins. New York: Macmillan Company. 346 pp. $5.75.

IF Eli Whitney had not first invented the cotton gin, his even more important work in initiating standardization in the manufacture of firearms and thus fathering the mass-production technique which has put America into industrial leadership would be more widely recognized by all. The present volume supplies many details of the story.

Though Whitney's life and work is the core of the book, the title is fully descriptive of the contents, for the authors range well over the civilized world of Whitney's time in evaluating his works and in tying together much of the extant philosophy,

Specialists in ORDNANCE WORK

U. S. Ordnance and **Aetna-Standard** have worked hand in hand for the last decade on several important contracts. Recently, we completed a large production run on a jeep mount for a 105 MM recoilless rifle. We are busy on two other long-range contracts . . . one for an anti-aircraft gun and the other for an anti-tank gun. In addition to the production, Aetna-Standard assisted in the design and pilot models on both of these items. Below you see the big Ordnance assembly floor in Aetna's Ellwood City, Pa., plant.



The big assembly floor in the Ellwood City plant is the center of activity for Ordnance work.

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MEMORANDUM

To: Ordnance Engineering Officers

From: Gear Specialists

Subject: Solution to Gearing Problems

For more than 50 years our engineer-specialists have successfully met and solved problems in the design and application of high precision gears.

This invaluable experience is available to you, either on a consultation basis when you need an 'engineering assist' – or, in the form of Fellows equipment best suited to your needs of cutting, finishing and testing gears for all branches of the service.

If currently faced with a gearing problem, a call or letter will bring a Representative. No obligation, of course.

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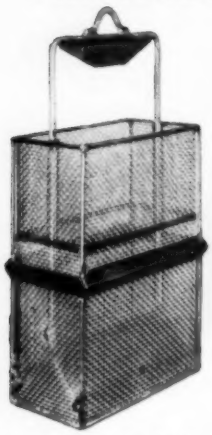
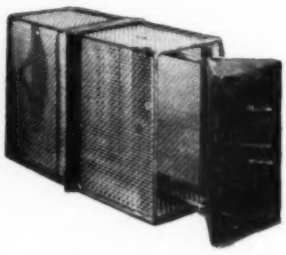
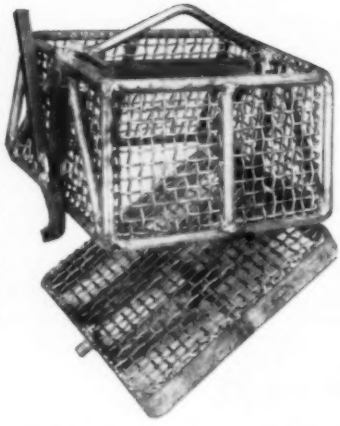




Both baskets were fabricated-welded from alloys best suited for the exposures and, like other Rolock products, were job-engineered to suit the specific use. Among the thousands of designs created by Rolock engineers there are many that, with slight changes in shape or size, will fill the requirements of your heat treating plant or department.

To help you solve such problems we offer two excellent catalogs . . . No. B-8 Heat Treating Section and No. B-9 Corrosion Resistant Section. They picture and describe a great variety of designs in Baskets, Crates, Trays, Racks, Fixtures, Screens, Grids, Retorts, Muffles, Tanks, Sinks, Hooks, Chains, etc.

We have put more practical material into these catalogs than you will find in any other similar publications. COPIES ARE AVAILABLE ON REQUEST.



Drop-bottom salt pot basket (top) has lifting bars attached to solid sheet bottom. When assembly sets into holder frame over quench tank, bottom drops, releases load.

Above is a heavy duty basket with extra rugged hinged bottom, released instantly by disengaging lever from pin. Note single point suspension.

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Book Reviews

economics, and knowledge. This results in much that is of benefit to the reader and, frankly, a good deal that is tiresome.

But the presentation of Eli Whitney as a great creative intellect is well done, and his contracts with the Government, particularly his dealings with the early Ordnance Department, form an outstanding example of understanding and coöperation which resulted in tremendous advances.—F. W. FOSTER GLEASON.

Harwell—The British Atomic Energy Research Establishment. Prepared by the Ministry of Supply and the Central Office of Information, England. New York: Philosophical Press. 92 pp. $3.75.

HARWELL, better known to Americans as England's Los Alamos, is ably described in this publication. This story of Britain's atomic-energy laboratory will be enjoyed by the layman for its simplicity, clarity, and amply illustrated explanations of many of the nuclear physicists' working tools such as the atomic pile, synchrotron, and electromagnetic separator.

In its reading the American physicist will gain a new insight into how his British colleagues are approaching and solving many problems of common interest. He will find that there are many others striving to turn their knowledge of the atom into peaceful applications rather than toward better instruments of war.

The work at Harwell is divided into clearly defined programs such as the production of radioisotopes, the generation of usable power by nuclear fission, and basic research in all aspects of atomic energy. The scope of these programs is discussed in detail with excellent descriptions of available facilities.

Finally, there is an account of Harwell's arrangements for coöperation with England's leading universities and for enlisting the aid of industry in the work of the laboratories.—MAJ. G. H. DREWRY, JR., *Office, Chief of Ordnance, United States Army.*

Jan Christian Smuts. By J. C. Smuts. New York: William Morrow & Company. 496 pp. $6.

WHEN Jan Christian Smuts died a few months after his eightieth birthday, Winston Churchill called him "a warrior, statesman, and philosopher who was probably more fitted to guide struggling and blundering humanity through its suffering and perils toward a better day than any one who lived in any country during his epoch."

How well this tribute to the great South African leader was merited is amply proved in this moving portrait of a father by his son. The younger Smuts calls his

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AMPEX magnetic tape permanently records data in electrical form. Data reduction can then be carried out any time, any place and in any way. This eliminates the need for complex filter and discrimination systems at each ground station. This frequently lowers ground station cost and complexity to one-third that of alternative installations. Use of fewer mechanical and electronic components also decreases the chance of losing any critical data.

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- *Records frequencies up to 100 kc. (including all RDB bands)*
- *Records the output of one to four receivers*
- *Overall playback error less than 0.7% on final data*
- *Less than 0.1% peak-to-peak flutter and wow*
- *Ruggedly constructed to meet military requirements*
- *16 minutes recording time at 60-inch tape speed*

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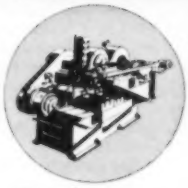

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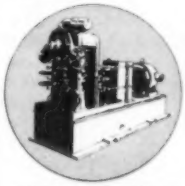
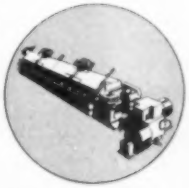
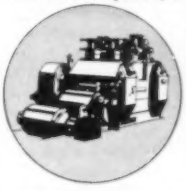


MILL MACHINERY — Rolling Mills: Strip, Rod, Tube, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc.

WIRE MILL EQUIPMENT — Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers • Swagers • Bull Blocks • String-up Machines • Spoolers, etc.





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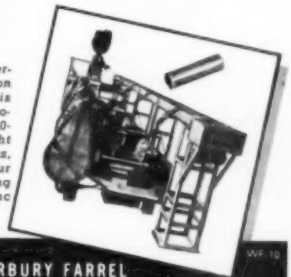

WF-10

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work an "interim biography," and acknowledges that it is written in a mood of eulogy. It is eulogy, however, that is eminently deserved.

Smuts played such an important rôle in so many phases of the latter part of the nineteenth century and the first half of the twentieth that it would be impossible to separate much of the history of the era from the facts of his life. He was born of Dutch ancestry but was a British subject by reason of his birth in the Cape Colony. He gave up his British citizenship, however, and moved to the South African Republic where he became a leader of guerrilla forces in the Boer War.

When it became evident that coöperation was necessary to the future greatness of the country, Smuts influenced the establishment of the Union of South Africa. Ample space is devoted to his rôle in military events of the two World Wars in establishing grand strategy and in the efforts to devise a world organization.

Korea was a great source of worry to the aged Smuts, and it is interesting to note his comments about Asia written in a letter in 1950:

"Personally I expect very little real response from Russia. Russia is on the march, unopposed, to virtual occupation of the Far East which other European powers have evacuated. This is a conjunction of circumstances which has given her a unique opportunity of which she will avail herself to the limit. It is a fateful prospect, not only for the Far East, but for Europe and the whole world.

"I sometimes think we do not realize the significance of this moment in world history. The only cheerful possibility is that she may leave the West alone and give it an opportunity to integrate and consolidate itself on a scale which will be worthy of the opportunity."

In other words he believed it necessary for the West to concentrate on the real focal point of the Russian threat in Europe.

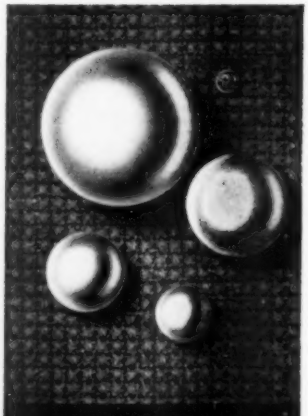
This biography is not only the stimulating story of a great character and personality but it is also an historically valuable picture of the resources, political problems, and the racial dilemmas in a continent of growing importance in future world history.

The younger Smuts is not a writer to slow down the swift pace of his story with the minutiae of history and biography. He has successfully recreated his father and his father's epoch in vivid terms of human relationships and human values.—DONALD ARMSTRONG.

Korean Tales. By Lieut. Col. Melvin B. Voorhees. New York: Simon & Schuster. 209 pp. $3.

HAILED as a top-flight writer by experienced critics, Colonel Voorhees, who

a metal ball PROBLEM?



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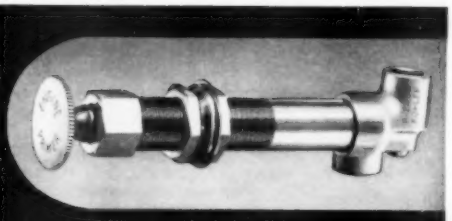

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broke off a promising newspaper career for nine years of soldiering, mingles his experiences and his reflections in a pungent and most effective manner. It is a collection of essays, each depicting one aspect of the war, rather than a chronological record.

Essentially factual, it yet is half fiction developed from small notes from the combat record. Throughout, it reflects the greatest sympathy for the Korean people —real victims of Red aggression.—F. W. Foster Gleason.

Fatigue and Fracture of Metals. Edited by William M. Murray. New York: John Wiley & Sons, Inc. 313 pp. $6.

THIS work consists of the compilation of fourteen individual papers presented at a symposium at the Massachusetts Institute of Technology in June 1950 on the fatigue and fracture of metals and covers many of the aspects of the titled problems from both a basic research as well as from a practical point of view.

The book is well illustrated throughout by photographs, graphs, and other explanatory diagrams which make for simplicity in understanding even the more theoretical papers.

The studies provide a background relative to the fatigue and fracture problems and bring the reader up to date concerning current research trends. Although the various authors have refrained from encumbering the reader with bulky specific data, there are appended throughout the book some 250 references which the more demanding reader can, if he desires, readily consult.

The authors are among the outstanding experts in their respective fields; accordingly, the book should prove valuable to all those interested in research or design involving materials behavior. The editors and publishers are to be congratulated on their fine job of presenting this symposium in published form.—Joseph I. Bluhm, *Watertown Arsenal Laboratory, Watertown, Mass.*

Ersatz in the Confederacy. By Mary Elizabeth Massey. Columbia: University of South Carolina Press. 233 pp. $5.

THIS book is a result of the effort of an historian to find out how the people on the Confederate home front managed when cut off from practically all customary supplies. The book indicates an amazing amount of painstaking research into files, newspapers, letters, books, and reports of the Civil War period, and the author has packed into the volume a host of examples of shortage items and how substitutes were contrived.

It is really a research compendium, and does not attempt to summarize broad con-

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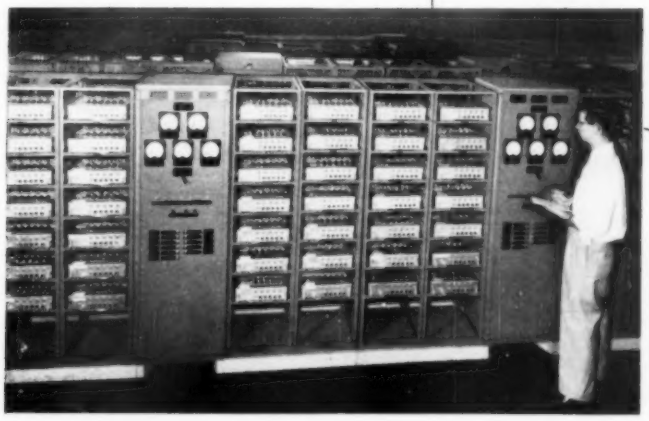

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clusions, but it should be of value to any one who wants to study the effect of a siege war on a civilian population. Although products have changed since 1861-1865, principles have not changed.

What made conditions particularly bad for the Southern population was that the South, though willing to fight a long war, never got down to planning for a long war. Although the governors flooded Richmond with complaints of the distress of their peoples, Jefferson Davis never took a positive stand on any definite program.

No organized plan for general supply came forth in the four years, as the leaders went along on a high note of confidence, always waiting from day to day for the sensational to happen, for a recognition by England and France, or for the North to tire of the war.

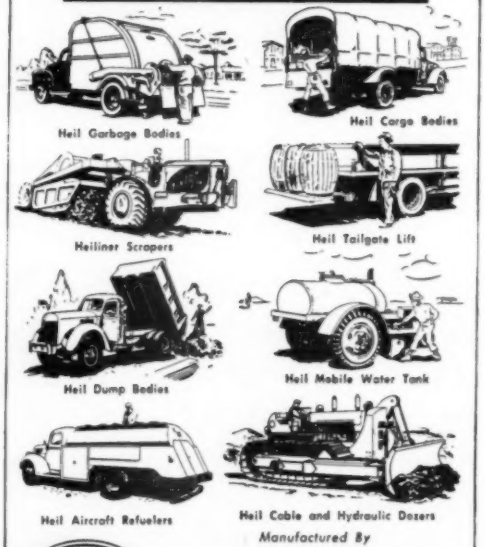
Southern sympathizers managed to get large quantities of arms and ammunition moved to the South before the war, but they forgot the importance of railway cars, rails, repair parts, telegraph materials, and machinery. They also forgot tools, and by 1863 there were few axes, shovels, saws, or anything with which work could be conducted on the farm, at home, or in the scantily equipped factories.

The impressment law and the "tax in kind" that required one-tenth of the farm produce for the army actually decreased production. Farmers did not want to sell produce for paper money that was constantly decreasing in value.

At the time of Lee's invasion of Pennsylvania, the clothing situation even in the army was disastrous, and it was the raiding of the shops in Gettysburg for shoes that precipitated a battle that Lee did not want at a time when every vehicle in his army was loaded with plunder to be shipped south.

This book makes interesting reading. If you are looking for a serious study from the military angle, you will have to draw your own conclusions, but there is ample case material for such a study.—GEORGE S. BRADY.

Heil Service Veterans



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Book of the Month for March

THE NEW BREED

By ANDREW GEER

Here is a carefully documented history of the Marines in Korea in the bitter winter, spring, and summer of 1950-1951. "The New Breed" is a story of individuals, of small-unit actions taken from the author's personal experience and from 700 combat interviews. From these records of battles in miniature you'll be able to judge for yourself the validity of Marine doctrine on both amphibious landings and tactical air support of ground troops. You'll see, too, the justly famous Marine discipline—how it works and why it works, even under terrible hardships. Retail, $3.50.

TO MEMBERS, $3.15

WINCHESTER

THE GUN THAT WON THE WEST

By HAROLD F. WILLIAMSON

This detailed, documented record of a great American arms company is virtually the first real coverage of a name which was a synonym for "rifle" for two generations. In addition, you'll find photographs and information on every model Winchester firearm ever made, tables of cartridges listed for commercial sale by Winchester, and cutaway views of major Winchester arms. 494 pages and more than 200 illustrations. Retail, $10.00. To members, $9.00.

ASIA AFLAME

By EBED VAN DER FLUGT

Gen. Albert C. Wedemeyer says of this book that the author correctly places social, political, and economic forces above military force in gaining the ultimate defeat of the Asian Communists. Van der Flugt deals, too, with the vital question of our supplies of raw materials from the Far East. Retail, $6.00. To members, $5.40.

JAN CHRISTIAN SMUTS

By J. C. SMUTS

Here is both a general biography and an intimate family portrait of a statesman, soldier, and philosopher who held the world stage for half a century. Once Britain's enemy, he fathered the "Commonwealth of Nations" and held South Africa together for a generation. His son now writes of the acts and motives of a great man. Retail, $6.00. To members, $5.40.

PEACE THROUGH STRENGTH

By MORRIS V. ROSENBLOOM

An appreciation of the preparedness plans of Bernard Baruch, adviser to America's leaders, economic and production trouble shooter on the Nation's problems from rubber to atomic energy. Retail, $3.95. To members, $3.55.

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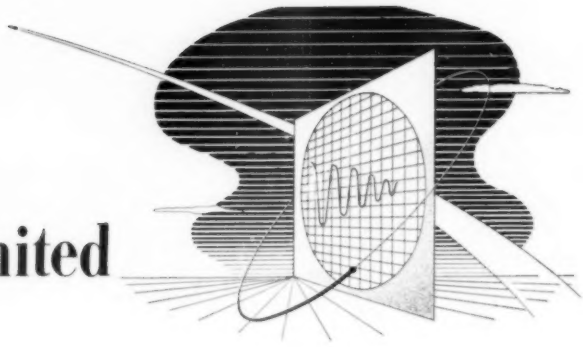

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has earned its place among the leaders in precision instrumentation on the record of its virile development and production staffs. Throughout its cumulative years of accomplishment, Ketay has confined its efforts to the development, engineering, and production of new types of electro-mechanical and electronic equipment.

Today, industrial and government orders almost fill the Ketay plants on both coasts. Currently in production is the miniturized highly precise Ketay Resolver—a type which opens new horizons in automatic control operations. Ketay developments are geared to performance above and beyond present military standards—which, in turn, were set by earlier Ketay product capabilities.

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For your expanding ordnance requirements—consult Watson-Stillman first . . . experts in transforming *hydraulic* power into *fire* power.

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W-S HYDRAULIC

ESTABLISHED 1848

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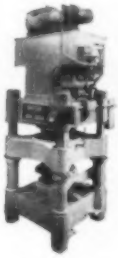

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DIVISION OF H. K. PORTER COMPANY, INC.

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All National Seamless Tubes are pierced from a billet of high quality steel. This is the one manufacturing method that assures absolutely uniform wall strength.

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UNITED STATES STEEL

GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245)	
Grade I	Bonderite 100, 125, 140, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 700 (chemical film for aluminum and its alloys)
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 125, 140, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 125, 140, 160, 170, 180
U.S.A. 57-0-2	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 125, 140, 160, 170, 180

For information regarding these or other specifications, write

PARKER

RUST PROOF COMPANY

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Cork-and-Rubber Gasket Materials

Armstrong manufactures cork-and-rubber gasket materials made to meet each class of the principal government specifications covering cork-and-rubber gasket materials.

Specification	Material
MIL-G-6183	
Type I Soft	NC-709
Type I Medium	NC-710
Type I Firm	NC-711
MIL-T-6841	(DK-153 (RK-304S
Type II Soft	DC-167
Type II Medium	DC-100
Type II Firm	DC-113
MIL-G-6747	DK-149

Write for samples and 24-page gasket design manual.

ARMSTRONG CORK COMPANY
2405 Arch St., Lancaster, Pennsylvania

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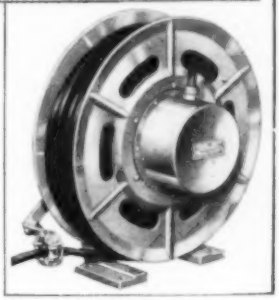

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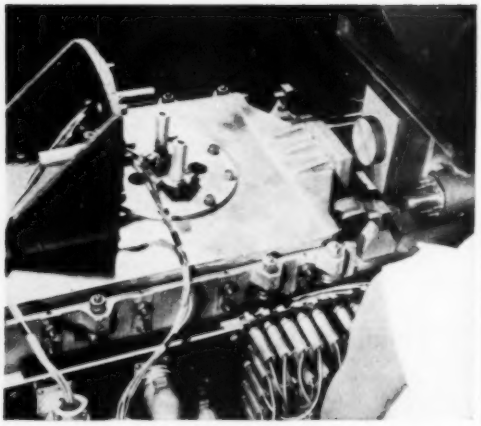

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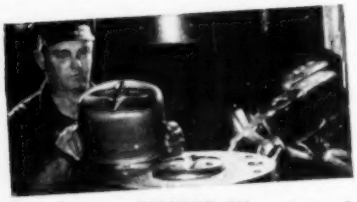

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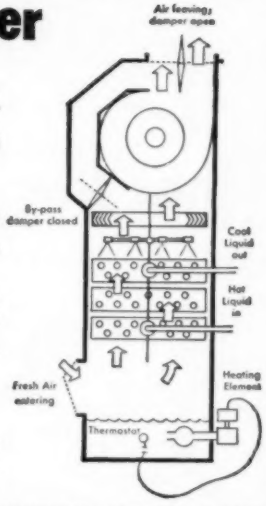

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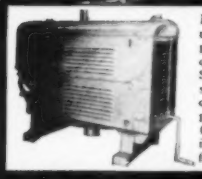

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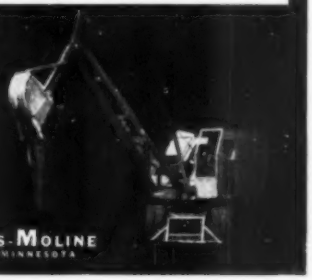

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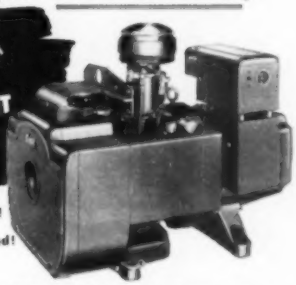

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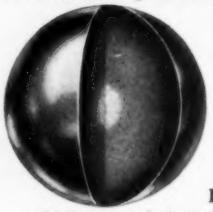

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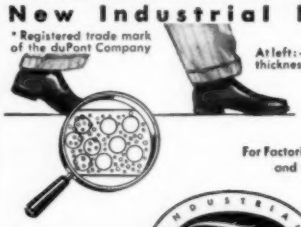

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Whiz Specification Corrosion Preventive Compounds for Government Contractors

Specification Number	Trade Name
MIL-C-972, Grade I (Superseding 52-C-18 Grade I)	Klad Kote 101
MIL-C-972, Grade II (Superseding 52-C-18 Grade II)	Klad Kote 122
MIL-C-6708, Type I (Superseding AN-C-52b Type I)	Klad Kote 102
MIL-C-6708, Type II (Superseding AN-C-52b Type II)	Klad Kote 252
AN-C-124a, Type I	Klad Kote 124
AN-C-124a, Type II	Klad Kote 224
AXS-673, Rev. 2	Klad Kote 103
AXS-1759, Grade I	Klad Kote 171
AXS-1759, Grade II	Klad Kote 172
AAF 14156, Amend. 1	Klad Kote 356
USA 2-122	Klad Kote 322
USA 2-121	Klad Kote 221
AN-VV-C-576b, Type I	Klad Kote 376
AN-VV-C-576b, Type II	Klad Kote 378
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Anti-Seize Compounds: MIL-C-5544 – JAN-A-669.
Aircraft Cleaning Compounds: Army Air Force AAF 2015-E – Navy Aero C-147.
Non-Inflammable Hydraulic Fluid: Navy BuAer MIL-F-7063
Protective Coating: Army Ordnance AXS-1756 – Navy Ordnance 52-C-44.
Paint Remover: Navy BuAer 52-R-15, Amend. 1.
Carbon Removal Compound: Army Air Force AAF X20043-A.

Write: INDUSTRIAL-AVIATION DIVISION

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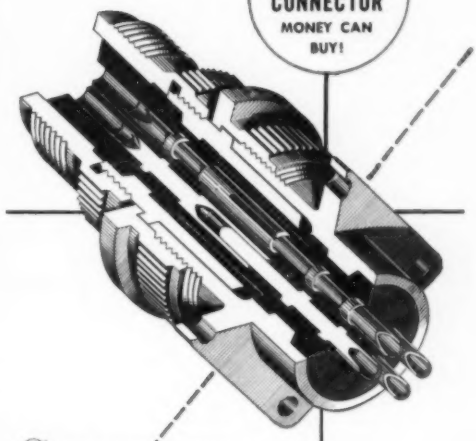

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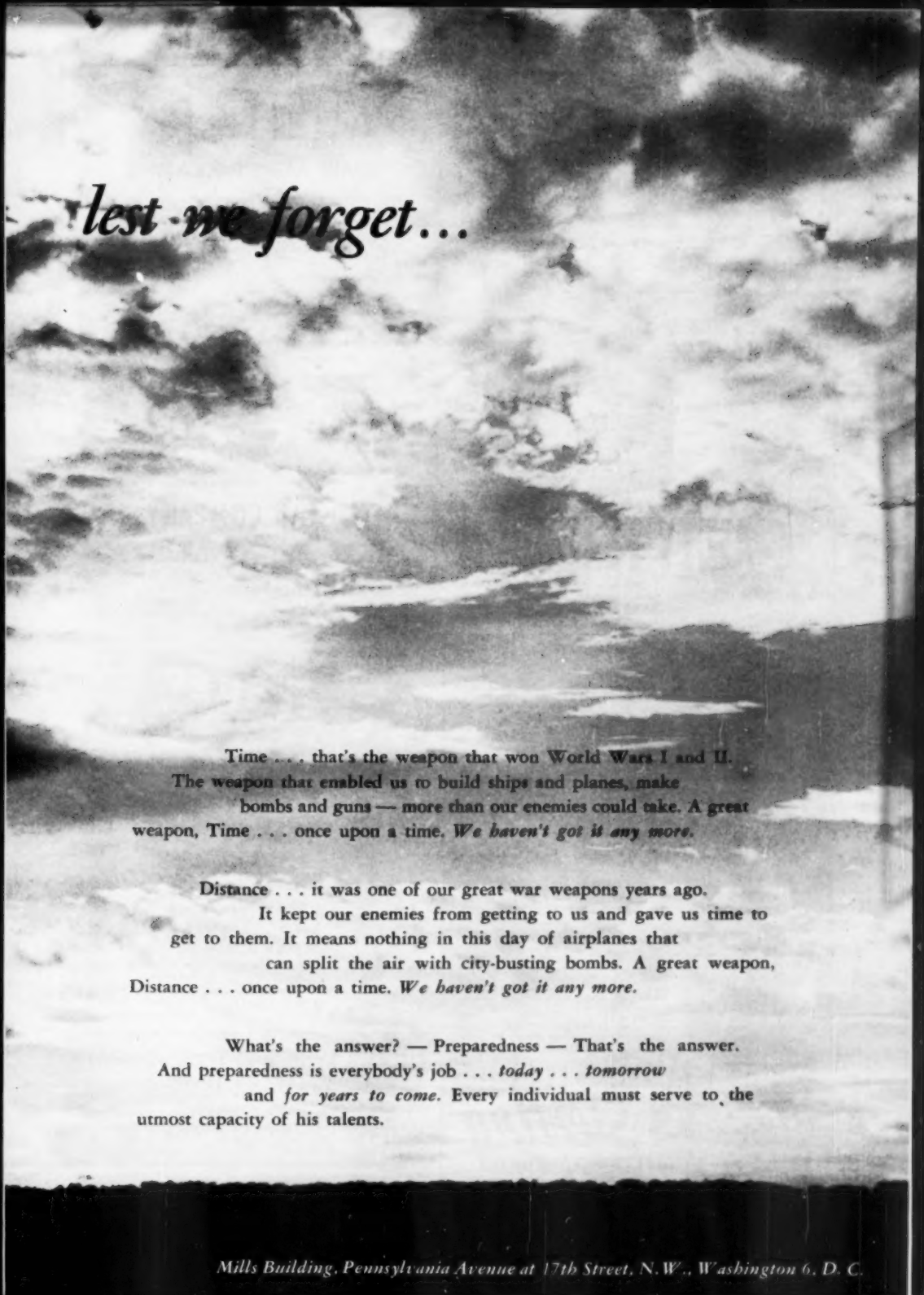
They will attain their goal *only with the wholehearted and unflinching support of ALL members.*

American Ordnance Association



Time . . . that's the weapon that won World Wars I and II. The weapon that enabled us to build ships and planes, make bombs and guns — more than our enemies could take. A great weapon, Time . . . once upon a time. *We haven't got it any more.*

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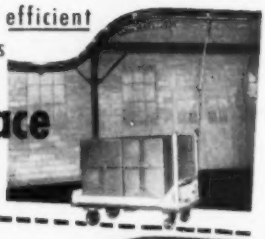

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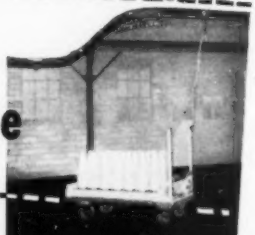

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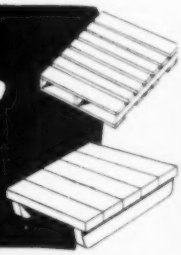

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The Trophy was established in 1938 by citizens of Auckland, New Zealand, in memory of Capt. Edwin C. Musick and his six companions in the "Samoan Clipper" who were lost in the South Pacific on January 12, 1938 while making the first commercial flight from the United States to New Zealand.

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Soviet Ordnance

Though Rough in Appearance It Is Effective in Action

Col. G. B. Jarrett
Director, Foreign Matériel Museum, Aberdeen Proving Ground, Md.

WHAT is there about Soviet armament that puts it in an unusual class? And its engineering characteristics—are they as compelling as the headlines make them out to be? Answers to these and other questions about Soviet ordnance can be as controversial as they are timely.

Communist Threat

This discussion is entirely the personal opinion of the writer and in no manner reflects that of any official source within the Department of Defense. If discussion of these matters suggests a new line of thought, it will have served its purpose. It is indeed time that both official and nonofficial circles realize the danger of the Communist threat and understand why and how they devised their tools of war.

This discussion will be confined to ground-force weapons, which means those on their carriages or supporting devices (including the soldier), the accompanying fire control, and, of course, the ammunition involved. Logistics enters into this problem, too, and it covers the manufacture of matériel, plus getting it to the battlefield where and when wanted.

The battle is the pay-off—on that all agree. Let us see how deeply the Soviet mind appreciates this battlefield performance. The Reds fully realize that a day may come when they will have to fight on the battlefield after exhausting all forms of trickery through legitimate agencies, such as normal diplomatic channels, and all forms of treachery by subversive activities.

That appreciation is and has been an integral part of Soviet planning and is reflected in the fact that one of their best and easiest-built machine guns started its career in 1928, long before Hitler planned his attack on Russia. Likewise, the T34 tank series was born long before World War II commenced.

Both these Soviet weapons carried a very heavy share of the task of destroying the German Army and contributed very effectively to the Allied effort because, thereby, a lesser German potential was available to resist our own European invasion.

But when we examine these and other Soviet weapons, judging only by our own manufacturing standards, we are apt to receive a surprise.

Accustomed as we are to glistening automobiles, polished machinery, and beautiful design, the realization that the Soviet weapons, crude in appearance, rough in finish, and functional in design, are capable of sufficient performance that they can have a high pay-off, even though they may be cheaper than conventional designs, comes as something of a shock.

Numerous Advantages

Whether the price tag be high or low, Soviet matériel, as evaluated from operational reports during World War II, has a number of distinct advantages—but not at first sight! The average American's first reaction after viewing Soviet ordnance is that it must be quite inferior because it presents a poor or rough "appearance." Yet millions of dead German soldiers provide mute testimony to its real battle effectiveness.

It is impossible to understand Soviet matériel unless we approach it from the Soviet viewpoint. To reach that viewpoint we must try to discover what they want in a piece of ordnance

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The Soviet 7.62-mm. bolt-action rifle now in use is a shortened version of the original 1891 rifle.

and what they expect to accomplish with it.

The Soviets are realists, and being so they design their ordnance matériel from a realistic standpoint. They know, for example, that no matter how long the life span of a given piece of ordnance is, the day is rarely seen when the piece "wears out." The loss of weapons in combat far exceeds the normal loss due to wear and tear.

Hardy Soldier

The average Soviet soldier can endure much harder work than the average American. For generations the engineer in this country has striven to ease our lot and in doing so has obviously lessened our ability to stand privations. As creature comforts increase hardihood decreases.

It is doubtful if designers and engineers outside the Soviet sphere have considered the full effect of battle attrition as understood by the Soviet mind. We Americans guard against attrition when buying an insurance policy on a new car. But surely quality in one's automobile plays only a very small part in assuring a safe journey along a highway where another vehicle can run into it.

Battle attrition, therefore, has nothing whatever to do with quality. Battle attrition can write off an entrenching shovel or a tank without the slightest credit to all the quality which was designed, developed, and built into it.

The Soviets believe that there is no sense in building into an appliance any "fancy" features or giving a finish to the parts which makes for beauty. Nothing need be built into the equipment except that which serves its purpose and thereby aids it to accomplish its mission. Producing any item with a life span in excess of a true assessment of its battle expectancy only takes more raw materials and man-hours to produce. The Soviets waste neither, as they are thoroughly aware of the life of both the equipment as well as the troops who use it. Thus they build into their weapons only enough to do the job.

Below Our Standards

To make a beautiful rifle capable of thousands of rounds when an infantryman's actual existence in the front lines is a matter of days or hours doesn't seem worth while to them. Hence the Soviet rifle is serviceable but far below our exacting standards.

Functional Design

Consequently, one would conclude from a study of Soviet ordnance that in general they pay more attention to function than to appearance. In fact, they build nothing into an item that does not aid its intended purpose. In addition to this they strive for great simplicity, both in manufacture and maintenance. They try to make an item simple enough so as not to require the services of a specialist for its everyday maintenance.

A good example to illustrate this type of thinking would be to cite a railroad train running from San Francisco to New York. It could at the same time pull a Pullman car and a boxcar and, despite the difference in "quality" and cost of the cars, they both would reach their destination together.

In this sense Soviet tanks are "boxcars" but—this is the sad shock—they do reach their destination; they do fire their guns, and men die just as dead as

The 7.62-mm. Sudarev Model 1943 submachine gun. When magazine and weapon are matched it delivers deadly fire.

The 7.62-mm. Tokarev semiautomatic rifle Model 1940 has poor magazine interchangeability but accurate fire.

if they had been killed by a tank of higher quality.

The point simply is that so much of what we design and build in this country is "Pullman-car" comfort, while most of that made by the Soviets is of cattle-car quality. Surely somewhere in between lies a suitable compromise—a coach-type accommodation. Battlefield attrition pays not the slightest attention to quality, consuming anything within its reach, good, bad, or indifferent!

This comparison clearly typifies the basic difference between Soviet and some more modern tanks. No one, after examining a Soviet T34/85 tank, could help but be unfavorably impressed with the miserably cheap tank, whose armor is so brittle that it is often referred to as a china teacup, whose power plant and suspension are such as to move the tank adequately only while the power plant works smoothly, whose room for efficiency of tank-crew operation, plus crew comfort, is decidedly inadequate by our standards.

Efficient Job

Yet this very tank did an amazingly good and efficient job of destroying and throwing a fine German Panzer army out of Russia in 1944-1945. Furthermore, the same now-antiquated, or at least obsolescent, tank did surprisingly well in Korea against United Nation units. Surely the idea of the railway coach suggests a happy medium between the Pullman and the cattle car.

Weapons Examined

Let us briefly examine a few Soviet weapons and see how the above-mentioned thinking is reflected in their design.

The first weapon we shall consider is the rifle, caliber 7.62-mm. Model 1891/30. This is a shortened version of the original rifle of 1891. This weapon is a bolt-action, manually operated rifle, with a 5-shot magazine.

Although the weapon appears crude and rough, it nevertheless is sufficiently accurate for all military uses. Its feeding of cartridges manually is poor, largely due to the Soviet rimmed cartridge, yet its accuracy is quite deadly. For sniping, a scope is furnished with conventional mountings on a selected rifle.

In order to satisfy the requirement for a semiautomatic rifle the Soviets, after considerable experimenting before World War II, adopted the Tokarev Model 1940. Again we find a simple but satisfactory weapon, easily manufactured. Its biggest drawback lies mainly in its poor magazine interchangeability. The magazine furnished with the weapon is fitted carefully, but as a rule no other magazine will allow the gun to function unless one works the magazine over.

This is a liability; nevertheless the weapon is deadly accurate at important battle ranges. Again, issues for sniping use are especially selected and furnished with scopes.

Submachine Guns

In the field of submachine guns the Soviets reached the ultimate in simplicity. Both the model 41 and model 43 employ stampings wherever possible. The entire operating mechanism is simple yet rugged. However, as with all Soviet matériel, interchangeability of parts is the exception and not the rule.

In order to function properly the magazine must be matched to the weapon. When a properly matched

The Soviet Model 1941 7.62-mm. submachine gun employs stampings wherever possible to simplify production.

Above, the 57-mm. antitank gun displays low silhouette typical of Soviet design.

Above, the 120-mm. trench mortar fires a 35-pound projectile 6,500 yards. Below, the T34 tank, roughly constructed yet a very effective engine of war.

magazine is used, this weapon functions very well. The extensive and widespread issue of these weapons within the Soviet Army and its satellites indicates that they must function properly else they could not commit units so equipped.

Machine Guns

The machine guns used by the Soviets are well designed and capable of delivering accurate, deadly fire. The light machine gun, Model DP, is a typical example of Soviet thinking. This weapon, like other Soviet pieces, is very simple in design and easy to manufacture. It was developed prior to 1928 and is quite light in weight. It is also like the others in that it has very poor interchangeability. Its pan magazine is not desirable, and the magazine used must be kept with the weapon for proper functioning. Yet if the weapon has several fitted magazines issued it is capable of putting up a long and sustained operation against an enemy.

When its reliability is based upon a well-trained team of men who understand their weapon and care for it, it is probably one of the most deadly light machine guns in the world. And if lost in action it represents a far smaller loss to the Soviet cause than would one of the costly weapons of a similar type found in the opposing armies.

Maxim Supreme

During the reign of the Czar the Maxim heavy machine gun, Model 1910, was supreme. This old but reliable weapon was continued by the Soviets far into the period of World War II. An interesting point lies in the recent remark of an ordnance technician writing from Korea: "The shame of it all is these Maxims always seem to work when often our own do not" (meaning United Nation weapons).

Returning to production, apparently manufacturing facilities were so deeply established with the Maxim as to make this long period of continuance mandatory. Nevertheless, plans had been laid long before World War II to get an even more satisfactory weapon of less complicated design into production.

By 1943 the Goryunov heavy machine gun made its appearance. It is by far one of the best heavy machine guns yet seen by the writer. It offers extreme simplicity of design, hence ease of manufacture. It steals the older

Hotchkiss design of gas-operated mechanism, the Italian quick-change barrel greatly simplified and is quite capable of delivering sustained fire. If the barrel overheats it can be changed in a matter of seconds.

It is a refreshing design as far as machine guns go. It is, generally speaking, so light as to represent no extra effort to move around; yet it is not too light for necessary accuracy when firing on a target, and thus because of its mounting is a heavy machine gun. Its wheeled mount is far more practical than ridiculous and a great advantage. This wheel idea originated with the Maxim prior to World War I.

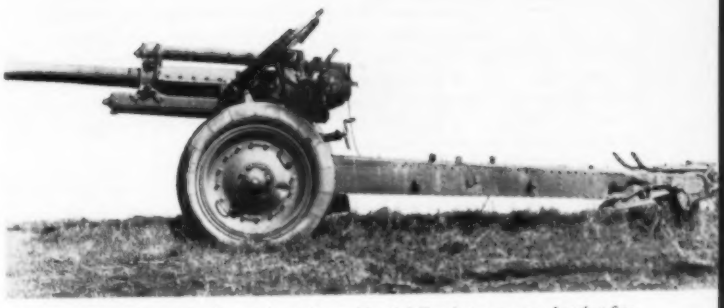
Cheap Cartridges

Cheaply made small-arms cartridges exist. These often are picked up after firing with cracked necks and cones, which most designers consider undesirable. Yet, while cracking in the weapon, they did not cause the weapon to have a malfunction. The gun fired and perhaps won for its operator a local decision there and then. So often a degree of perfection is sought by our own designers which, while wonderful and perhaps desirable, is often unnecessary. Again, attrition pays so little attention to unnecessary refinements.

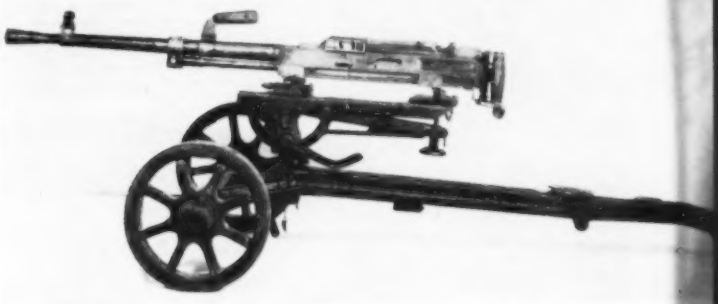
While years ago most nations relied on the 50-mm. and 82-mm. trench mortars, the Soviets looked ahead for a mortar that would deliver a far more potent round on the target. In 1938 they adopted a 120-mm. trench mortar which was light and easy to handle, yet threw a 35-pound projectile to a maximum range of 6,500 yards. This inexpensive but extremely effective weapon so impressed the Germans during their attack on Russia that they immediately copied it. Allied troops in 1944-1945 first felt the sting of this weapon as the Germans used many genuine Soviet mortars in France.

In Action in Korea

In Korea today, this same mortar wields its terrible effect on United Nations troops who have only the smaller mortars to counter it, although some U.S. 4.2-inch mortars have been in action. This 120-mm. trench mortar offers an optimum mortar design and was adopted by the Soviets who were sold on its potential value considerably before World War II days began.



The 122-mm. howitzer, above, is capable of delivering accurate plunging fire.



The Goryunov 7.62-mm. heavy machine gun, above, is one of the finest in its class yet extremely simple in design. Below, the 85-mm. antiaircraft gun, Model 1939.

In the late 'twenties development throughout Europe was toward producing some adequate armor-piercing ammunition and high-velocity guns to shoot it. German Rheinmetall engineers pioneered the work, and the Soviets realized the significance long before World War II began. They very early obtained a prototype German 37-mm. antitank gun but went one better and immediately made their version in 45-mm.

Design Improved

The first design took the date of 1932 and was improved in 1937. Both these weapons were better than the comparable German piece then standard in the German Army (1936).

Early in World War II the Soviets allowed the basic design to remain the same but increased the barrel length to achieve greater velocity. This became the model of 1942. As time went on the Soviets increased the caliber of their antitank guns to meet the greater threats due to heavier armor. However their whole antitank-gun design is characterized by low weight and low silhouette, but not at the expense of potential delivered punch. While many of their guns are not superior to those of other nations, each is decidedly adequate.

Soviet artillery design is in keeping with their over-all thinking. Their artillery, while not exceptional, is good and capable of delivering quite accurate and often devastating fire. They believe in artillery, and in World War II they unhesitatingly committed vast concentrations to prepare targets.

Fire-Control Matériel

Soviet fire-control matériel at the very least must be conceded adequate. Proof of this is the registry on the target noted in the forward areas of the Korean campaigns, where our matériel and our personnel have become casualties.

Regarding the fire control for their antiaircraft weapons, it seems obvious that they most likely have progressed beyond the conventional optical systems. Certainly the number of United Nations planes shot down in Korea would suggest this regardless of whether they have flown too low or not, or how many missions have been sent out.

Many of their high-explosive shells have very elementary fuze systems and not at all made to safety standards such as we know them. These fuzes are also used with the shells shot from the antiaircraft weapons, and due to the hits recorded on United Nations aircraft it certainly indicates reliable fuze and fire-control systems must be in use.

Many rounds of artillery and mortar ammunition are made with rough finishes and often merely greased for preservation. Their fuze systems are quite elementary, nearly always with only enough safety device provided to allow them to be shot and yet go off on impact as intended.

"'Spit and polish' appearance is not sought after. The time spent by other nations in improving the appearance of a piece is utilized by the Soviets in producing an additional item. And it is with this rough-looking but effective equipment that the Soviets intend to attempt the destruction of the peoples of the world."

Tank Development

It is in the field of tank development that the Soviets far outclassed their enemies. The T34 tank, for example, was considered by the Germans to be the most all-around dangerous weapon they encountered.

By 1950 standards the Russian tanks of the 'twenties and early 'thirties were nothing exceptional. However, Russian tank thinking was alert, and long before World War II the famous T34 was conceived. This outstanding tank displayed the ultimate in medium-tank design. The angular arrangement of its armor, its low ground pressure, its powerful Diesel motor and, at that time in 1941, the most potent weapon of its caliber and size in a tank at the front made it not only a highly maneuverable tank but a very efficient one.

In order to keep pace with modern trends the Soviets increased the effectiveness of the T34 by the very simple expedient of installing a larger and more powerful gun placed in a new turret. In this way the o'd tank was kept "modern" up to 1945.

Russian heavy tanks also went through a process of development ending in the JS III the front of which is adapted from the French Saint-Chamond tank of 1917.

Despite its armor thickness and large 122-mm. gun, the tank weighs only fifty tons. To some engineers and tank crewmen fifty tons is the limit. It is entirely possible that today this tank represents more of an optimum fighting vehicle than many of its contemporaries.

Soviet Characteristics

This very brief description of Soviet war matériel has attempted to show the realistic way in which Russian designers solve their problems. All Soviet equipment is characterized by the following:

1. Simplicity of design for ease of manufacture, operation, and maintenance. It is designed to be made by workers who in many cases have little or no training and whose backgrounds do not lend them much chance of ever being skilled workers at any trade. Further, the piece can be maintained and operated in the field by the soldier who doesn't even have the mechanical qualifications of the factory worker.

2. Economy of strategic or natural materials and assembly time.

3. Lightness in weight for shipping and handling.

That the equipment made by other than the Soviets is not good, is not the point. Indeed it is good! Matériel produced in American and British factories is without a doubt some of the finest in the world. Often, however, it has far finer finish, far greater quality, and far more gadgets than necessary.

Weigh Advantages

Perhaps it would be prudent to weigh carefully the presumed advantages of added features in modern fighting equipment that we might not produce overcostly items from a manpower-resources viewpoint. Theorists frequently confuse the basic values, trying to design an improvement when the unimproved device is already adequate. Increased cost is the result.

It will be folly to forget that any future war will consume such vast amounts of matériel that we will be forced to economize in order to keep pace with the replacement demands. One way to do this today is to differentiate between quality and refinement.

Preserving Our Mobility

The Protection of Vehicles for Shipment or Storage

Capt. Henry H. Jordan, Jr.

Ordnance Replacement Training Center, Aberdeen Proving Ground, Md.

PRESERVATION of military vehicles to prevent deterioration enroute to an overseas destination plays a vital rôle in the logistical support rendered our fighting forces in the field.

Vehicle Not Complicated

During World War I there existed no need for vehicle processing since vehicles were not technically complicated and there were relatively few motor vehicles in use. After the war, these vehicles remained with using units, and no storage problem existed.

The vehicle-preservation need arose in World War II. At the beginning of that war, shortages demanded direct shipment and immediate use of vehicles, but at the end of the war vast fleets were on hand throughout the world wherever American fighting forces were stationed.

Primary Problem

The primary problem in perfecting vehicle-processing methods has been the development of a material capable of sealing for an indefinite period of time openings such as hatch-cover and turret seams, exhaust pipes, and engine-compartment grilles to exclude the entry of water.

The first method used by Army Ordnance employed nonhygroscopic tape. However, this tape lost its adhesive qualities after short periods of time.

The second method consisted of overspraying the tape with a sealing compound, but, while better than the first method, periodic reprocessing of vehicles in long-term storage was necessary.

The next method adopted by Ordnance employed aluminum foil and bituminous mastic.

Striving for a better sealing material, Ordnance research and testing produced "Coating, strippable, adhering." This product is a synthetic rubber vinyl plastic material pigmented for protection from the ultraviolet rays of sunlight. Applied by spraying, this material produces a tough elastic film, highly resistant to abrasion. It remains flexible in extremes of heat and cold, and initial application affords universal protection during storage and shipment.

Moisture Resistant

Resistant to the passage of moisture, it also resists attacks by oils, acids, and alkalines and will adhere to any surface which is clean and free from oil and grease. As a sealing material it is considered to be superior to those previously employed.

To prevent damage, corrosion, or deterioration enroute, ports of embarkation have been charged with the responsibility of processing equipment received at the port in an improperly processed condition or not previously processed by the shipping installation.

While the concept of direct rail-to-ship loading of military vehicles represents the most efficient method of handling such cargo, the arrival of vehicles in a damaged or improper condition repeatedly frustrates the ultimate execution of this operation.

Disadvantage

However, if this concept of direct rail-to-ship loading were abandoned in favor of establishing expanded facilities at ports for complete processing of every vehicle prior to overseas shipment the following disadvantages would be encountered:

1. During rail shipments to the port, nonprocessed vehicles would be extremely vulnerable to deterioration and pilferage, and the number of vehicles delayed at the port for repairs as a result of such damage would increase considerably.

2. Total double handling in the port of every vehicle for processing prior to shipment.

3. Increased "in-port" time of all vehicles prior to shipment.

4. Duplication of effort in the case of vehicles shipped from depot storage.

Thus at the Seattle Port of Embarkation primary consideration was given to speed and economy in developing new vehicle-processing procedures. Immediately upon arrival of vehicles at one of Seattle's four major railroad freight yards, each piece of equipment is inspected to determine if damage has occurred in transit and to check the adequacy of preservation for shipment overseas.

Final tags, signed by the Ordnance inspector, are affixed to all vehicles passing this inspection, and the vehicles are routed to the Seattle Port of Embarkation for direct rail-to-ship loading. A rejection tag to prevent inadvertent loading aboard ship prior to correction of deficiencies is placed on each vehicle requiring repair or processing.

Mobile Unit Used

If the basis for rejection is such that processing or repairs can be performed at shipside, these vehicles are also routed to the port where one of two mobile processing units accomplishes the necessary work prior to loading.

If the scope of maintenance and preservation is beyond the capabilities of the mobile units, the vehicle is routed to the vehicle-processing shop and upon completion of work delivered to shipside.

Subsequent inspections are made prior to loading and again upon completion of loading aboard the vessel to insure that all equipment will reach its ultimate destination overseas ready for immediate tactical use or long-term strategic storage.

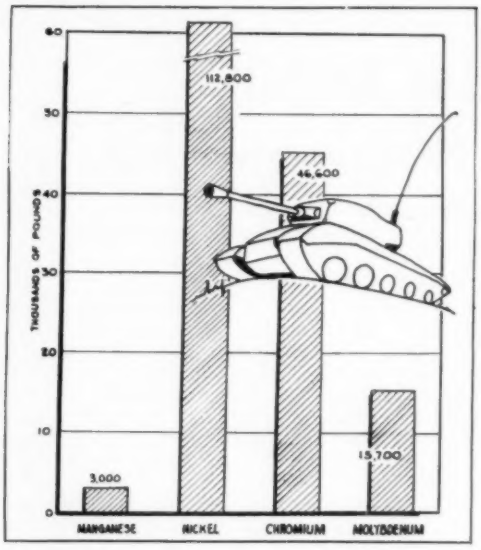


Fig. 1. Alloys saved in the tank-automotive program.

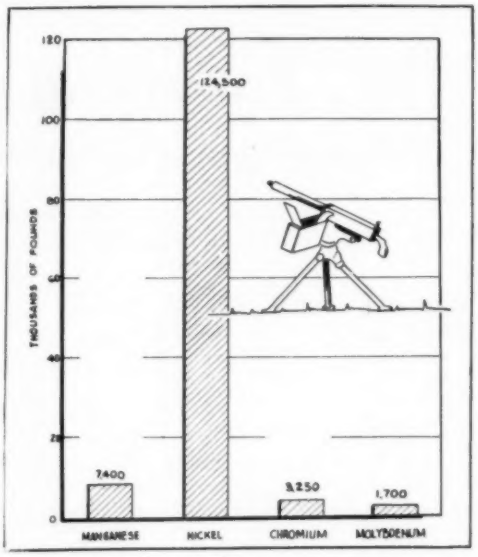


Fig. 2. Alloys saved in the weapons program.

Conservation in Army Ordnance

A Continuing Program To Husband Our National Resources

J. E. Walker

Research and Materials Branch, Research and Development Division, Office of the Chief of Ordnance.

IN conservation it is probably more true than in other work that the results of the past must be carefully evaluated. This step is most necessary to avoid previous pitfalls, but it is more important to take advantage of the store of prior knowledge.

This knowledge will serve as a guide for the problems of today as well as a record of good practices that have withered on the vine during the years of plenty which we have associated with the prevailing tenuous peace.

First Step

The first step in the evaluation of past work is to relate it to an "estimate of the situation" for the new job in hand. One such aspect is the atmosphere in which a conservation program must exist. For example, just what is conservation in the minds of people concerned with the production of military matériel?

Several Meanings

This word "conservation" has a very general meaning, and it also has what might be termed a "war" and a "peace" meaning. In peacetime we are most likely to think of it in connection with our forests, farmlands, rivers, and other similar natural resources. This type of conservation has many advocates and strong government organizations which vigorously prosecute a wise and continuing program. On the other hand, the "war" meaning primarily concerns the conservation of our critical materials which are predominantly the metals.

This latter form of conservation has not proved to be a popular one during the present so-called periods of normalcy, and supporters and those who labor in this field do so with many handicaps. Perhaps the following quotation from an address by Thomas Spooner, conservation specialist, Defense Production Administration, before the annual convention of management engineers, New York City, March 17, 1951, illustrates a portion of the difficulty:

Consider Conservation

"As we approach a state of all-out mobilization it is high time that this most wasteful people of ours give more serious attention to conservation. In this land of vast abundance, frugality is not

highly considered as a virtue, nor is it largely practiced, and as individuals we resent it when we are told that we can no longer continue our spendthrift habits.

"Under war conditions, when our resources do not meet the demand Washington must step in and prohibit certain uses and allocate materials to the most essential needs. It is in times like these that we hear most about conservation, for it is a most powerful tool for stretching our available facilities."

Complicated Problem

In this statement Mr. Spooner accuses every one. However, in all fairness it must be admitted that the military must shoulder a portion of the blame. And in further fairness, it can be stated that military matériel is unique in its severe service requirements and that therefore conservation is much more complicated than would be the case in civilian considerations.

Nevertheless the fact that it is a difficult job remains for several very important reasons, the most basic being: First, the general American philosophy that we have plenty of everything and therefore we need not be concerned with how much, or of what, we build our equipment.

Secondly, nothing is too good for the military simply because it is the military, and therefore the use of any material is justified on this basis alone, without consideration of the actual end use.

It is surprising how often this thought is brought to bear on material decisions. One is constantly rebuffed with: "Why should I try to conserve, and who will use the material I save?" or, "What is more important—weapons or washing machines?"

These are symptoms of a thought process which does not recognize that the prime mission of the military is to protect the civilian economy—not to weaken it.

Thirdly, it is not necessary to show a profit in the development and manufacture of military matériel, and thus the conservation concomitant with cutting costs is not a guiding principle.

Not Materials Expert

Fourthly, the military engineer concerned with air, sea, or land warfare is not a materials expert and the materials-engineering profession is so new that it is not as yet fully integrated into the military-design organization.

Fifthly, current practices and materials are well established and utilize extensive existing facilities. On the other hand, alternative materials frequently require a revolutionary change in practice and in some cases entirely new facilities. Admiration of the status quo is a formidable barrier to change.

We now find ourselves in a "war" phase of conservation with the unique situation of undertones of "peacetime" thinking. The high level of military production, combined with virtually a full-scale civilian economy, presents an unprecedented drain on critical materials.

Unique Problem

Never before have we had a problem similar to that encountered in the fantastic use of critical materials for the jet-engine program with its ever-increasing temperature and thrust requirements.

In this connection it is comforting to note that no revolutionary changes, comparable to jet engines, have taken place in ordnance matériel. True, the expected performance levels have been raised, but the target is still in sight without using tremendous amounts of any new or critical material in any one item.

However, because of the acceleration of ordnance production it is necessary to reckon the consumption of critical materials in ever-increasing quantities due to volume alone.

Fig. 3. Alloys saved in the ammunition program.

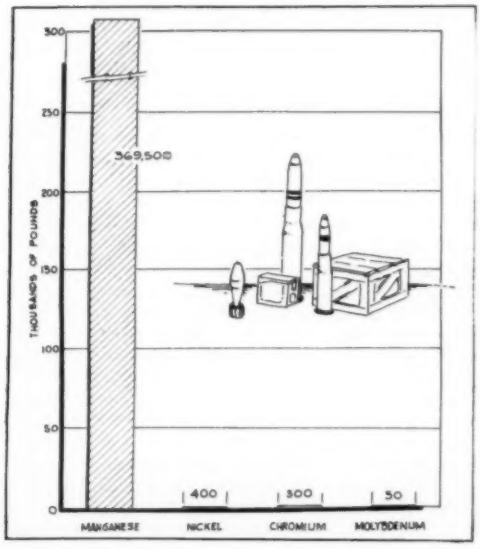
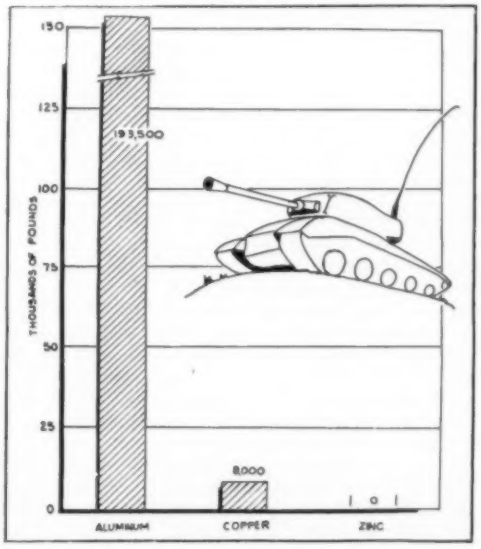


Fig. 4. Nonferrous metals saved in the tank-automotive program.



It is at this stage of the game that we find that we are competing in a limited materials market, and our bargaining power has a relatively short "lever arm"; that is, air power presents its huge requirements which, in turn, sharpens the competition between the other services for the remaining materials.

Insufficient Materials

As an illustration of the seriousness of the situation, it has been repeatedly stated that there is an insufficient supply of certain critical materials, considering the entire world production, to fulfill proposed programs. Therefore something must be done to enable us to reach our objectives with what we have available.

There are many suggested remedies for these serious material-shortage problems, but by far the most promising is what we choose to call "conservation." This is a choice that in rather simple terms means to use every ounce of material to its fullest advantage in every single application, taking full cognizance of the relative criticality of all materials.

There is every reason to say that this is just good materials engineering or a good appreciation of the national economy.

It seems appropriate at this point to introduce one more important consideration. It must be borne in mind at all times that military conservation is aimed at the so-called "full mobilization." The hectic day-to-day hue and cry of plenty today and scarcity tomorrow cannot be considered. The acid test is just how much, and of what, we must build our war machine when that time comes.

Trying Difficulty

Of all the difficulties which must be surmounted this is perhaps the most trying because the press as well as pressure groups constantly bombard our people with "facts," figures, and just plain sales talk. But it is imperative that the Ordnance Corps program be based on a firm foundation for mobilization rather than the ephemeral hurly-burly of the market place.

With the foregoing considerations as guideposts, the Ordnance program was intensified about a year ago and has been gathering momentum ever since.

As the program unfolded, the following subdivisions of effort were recognized. First, and perhaps the most difficult job, is to "sell" conservation; that is, to combat previous thinking which resulted in a somewhat generous use of critical materials and instill a desire to treat materials as a much more important factor than has heretofore been the case.

Conservation considerations must be made one of the prerequisites of all design and manufacturing procedures. To be effective, this effort of selling the idea must reach the man who is in position to do the conserving.

In keeping with this thought, the major efforts have been directed at the eight manufacturing arsenals. The design and end-item specification authority is vested in the arsenals, and for the equipment in production it is therefore necessary to turn to them for action.

Primary Efforts

The primary efforts were directed at becoming acquainted with the responsible groups and supplying them with useful information and guidance. These facts were to serve as a foundation on which to build a constructive program since it was soon discovered that the flow of public information was not the type which stimulated action, simply because it did not consider the unique military situations and thus did not supply the material on which a plan of action could be based.

Probably the most important phase, and next to be considered, is the review of all existing drawings and specifications by teams of designers and materials engineers. This is a long-time proposition but one which will pay handsome dividends.

The potential conservation inherent in this process is due to factors previously mentioned, some of which are: the generous use of critical materials in the past, the lack of expert materials knowledge by the designer working alone, and the prevailing confused public knowledge of the entire situation.

Again, this is a problem to be solved by the arsenals and the Research and Materials Branch, Office, Chief of Ordnance, in centralizing the program and in pointing out facts, philosophy, and information which will be of assistance in their efforts.

The main mechanism to make the above possible is the fostering and recognition of the materials-engineering groups throughout the various arsenals. Fortunately there are some bright spots in this program where the successful integration of materials and design work is nearing completion.

Difficult Matter

The story would not be complete without mentioning the fact that the establishment of a materials-engineering group is not an easy matter when one considers the difficulty the Government has in hiring engineers, together with the unprecedented shortage of materials men—especially metallurgists.

It is well worth mentioning that the assistance and coöperation of American industry has proved to be very valuable in the conservation program.

Since the same large manufacturers have strong materials-engineering groups and are confronted with similar problems of scarce materials, they are well able and most willing to make information on new developments available to the arsenals either through industry advisory committees or in connection with production contracts.

One of the fine industry efforts is the boron-steel program. The steel producers in collaboration with the pioneer users of the boron steels, as well as the many new users, have produced a substantial amount of useful data which have made possible the more rapid adoption of these steels.

Worth-While Savings

This program will continue to supply the data required to make the changes, in many cases, from the rich alloy steels to the very low alloy steels. As a result of this program it has been possible to make some very worthwhile savings in the ferro-alloying elements (nickel and molybdenum) which are discussed later in this article.

One other phase, somewhat related to the preceding materials-engineering considerations, is the fostering of conservation consciousness for the development projects already under way and the initiation of projects, the prime purpose of which is conservation.

There is also the likelihood that some projects should be expanded or redirected to include conservation phases.

A striking example in this connection is the rotating-band program at the Franklin Institute and Frankford Arsenal.

Band Materials

One phase of this project was to study and develop more effective band materials and methods of application. The regular gilding metal and other copper-base alloys, as well as plastics, were explored.

As the program proceeded, the possibilities of applying the gilding metal by welding methods looked most promising. But at this stage of the work the copper shortage entered the picture.

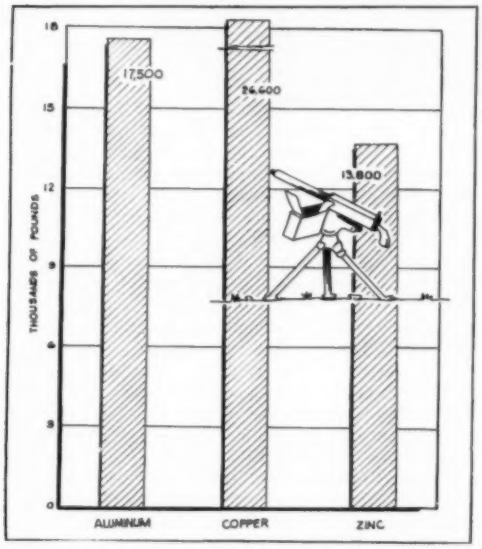


Fig. 5. Nonferrous metals saved in the weapons program.

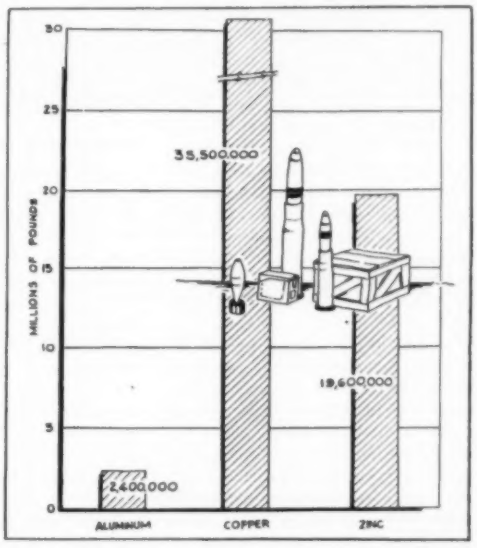


Fig. 6. Nonferrous metals saved in the ammunition program.

A careful evaluation of the previous work produced the idea that if copper-alloy bands could be applied by welding why not do the same thing with one of the least-critical metals, say iron, especially since it had been tried as a powdered metal.

The new shift in emphasis was prosecuted at a truly remarkable pace, and firing tests now under way show promise but have not been carried far enough to be conclusive.

It must be noted that this is a radical departure from the conventional pressure banding, and a change in production facilities of great magnitude would be necessary in the event that the new bands prove acceptable. This is a true conservation development because the potential copper savings are tremendous when one considers the quantities of projectiles required for an all-out war.

The other part of this phase of the work is encouraging the initiation of projects, the prime mission of which is conservation. In this field, generally due to the magnitude of any one undertaking, the conservation possibilities develop more slowly. A few of the initial projects concern the following types of endeavor:

1. The benefits to be gained (lower alloy content) by the use of boron in the special alloy steels used for Ordnance field matériel.

Rarer Metals

2. An investigation of the promising preliminary results obtained by using the recently publicized rarer metals which are claimed to make possible the lowering of alloy content while the important mechanical property levels are maintained.

3. A study of the possibilities of further extension of the use of severe quenching techniques (water, sprays, etc.).

One rather interesting program has been aimed at the replacement of copper in hand tools with either plastic or composite (plastic-steel) materials. (A surprisingly large amount of copper is consumed in these items.)

Materials Not Belittled

One other objective is never to belittle a material which is used in place of another material. The words "substitute" and "downgrading" are not found in the Ordnance conservation glossary. By attaching such names to any conservation action, a shadow of doubt is cast on the end product made of the alternative material.

This has a most disturbing psychological effect which acts to deter the progress of the program. It is not difficult to recall the disdain that was attached to the word "ersatz," but many of the things developed then are with us today as well-accepted products. This consideration is especially important since the prime over-all policy in making material changes is that the safety and military performance characteristics of Ordnance material must be maintained.

Now that the mechanism of the conservation program has been examined, the next step is to survey the results to

date. A regular reporting procedure for the arsenals was started approximately six months ago, but the process is not yet in high gear. However, difficulties are gradually being ironed out, and the program is accelerating quite rapidly.

The reporting procedure is one of the very essential phases of the program, since it is absolutely necessary to demonstrate, by means of quantitative figures, the amount of critical materials which have been saved—there is no other way to gage the success of the undertaking.

A Temptation

There is always a great temptation to present glowing qualitative reports of what is being saved. By this type of approach, plus a little effort on publicity, it is possible to make a voluminous showing of a seemingly fine program.

However, this sort of a report will not stand up under close scrutiny and will eventually prove to be a handicap when it is discovered that the information is idealistic rather than realistic.

In recognition of this possibility, the Ordnance Corps reports are quantitative and fully capable of substantiation by having the evidence to back them up.

In order to summarize the results for the last six months of 1951 a series of charts are presented herewith as Figures 1 to 6 for the most important materials. For simplification, certain related materials have been grouped together. For example, the classical division into ferrous and nonferrous metals serves very well, especially since ninety-five per cent or better of the efforts concern these metals. Within these divisions the results are presented under the major programs as follows: tank-automotive, weapons, and ammunition.

Ferrous Alloys Saved

Figure 1 covers the ferrous alloying elements in the tank-automotive program. The items within this group consume the largest proportion of the Ordnance alloy steels and large quantities of one of the most critical metals —nickel. It is, therefore, gratifying to note that the greatest savings shown are for this element.

While the figure of 112,800 pounds is not tremendous, it is of importance when one compares it with the Ordnance use of nickel during this same period (3,800,000 pounds for this program). At the same time there are indications that additional efforts on the conservation of nickel are in order because considerable nickel is still being used.

The savings for the other elements are also worth noting. In the case of manganese, one would possibly expect a better showing; but this will hardly ever be the case because as the other elements (nickel and molybdenum) are cut down, the use of manganese tends to rise.

Turning to the weapons program, we find in Figure 2 similar but greater savings. Here again the large nickel savings are to be noted. This program, as well as the tank-automotive program, is gathering production momentum, and substantial savings will be shown as time goes on.

Ammunition Program

In the ammunition program, Figure 3, the savings of the ferro-alloying elements are not as large as in the previous programs. This condition is primarily due to the excellent job that was done in this field during World War II, plus the most important fact that changes made at that time have been retained as standard practice for present production.

The significant amount of manganese saved is the result of changing from high-manganese hot-forged steel to a low-manganese cold-formed steel projectile. Several new programs which envisage the use of boron-treated steels or other lower-alloy steels are under way and show great promise.

Figure 4 presents the conservation of nonferrous alloys in the tank-automotive program. Here again it is comforting to note that the largest saving is in connection with one of the problem metals—aluminum. It is not expected ever to show great savings in this field because the proportion of nonferrous to ferrous metals in a vehicle is very small.

The next figure, No. 5, covers the nonferrous metals in the weapons program, and here a similar situation to that found in the vehicle group is encountered. However, it has been possible to show some savings, and in the future it is expected that better results will be possible as more and more items are subjected to a materials-engineering study.

The last figure, No. 6, for the ammunition program, is the brightest spot of all. Normally this program consumes the greatest amount of nonferrous metals and, therefore, greater savings are to be expected. However, a glance will disclose that the savings are indeed impressive.

28 Million Pounds Saved

For example, on a quarterly basis the Ordnance requirement for copper-base alloys was about 170 million pounds, but during this same period about 28 million pounds were saved.

In the case of aluminum, the saving of 1.2 million pounds compares with a requirement of about 35 million pounds —in this instance, a small proportion but a worth-while one.

Future prospects for aluminum savings appear to lie in the field of improved manufacturing techniques which will result in less scrap. This, too, is effective conservation.

A complete picture of the Ordnance Corps' position in the field of conservation must of necessity include some consideration of the projected activities by means of which the program will be strengthened and continued.

First and foremost is the "selling job"—the task of convincing the designers, engineers, and other groups that conservation is a necessary part of all thoughts and actions in the process of developing and producing Ordnance matériel. And, above all, every one must be thoroughly indoctrinated with the philosophy that military production must be planned on the conditions which will prevail during full mobilization.

Engineer on Team

Secondly, and in the sense of immediate results first, is the establishment of the materials engineer as an integral part of the design team.

Thirdly is the widest dissemination of accomplishments in order to assure that the Ordnance Corps receives critical materials when they are absolutely necessary as well as proving that the well-being of the country is of concern to the military.

And, finally, is the instilling of the idea that conservation is not a weapon to be unsheathed only in emergencies.

British photo

The Centurion Tank

Britain's New Combat Vehicle Is an Outstanding Weapon

Lieut. Gen. H. G. Martin

THE evolution of the British Centurion tank dates from the later stages of World War II. Throughout the earlier stages the shortcomings of Britain's tanks had been notorious. In Hitler's Germany for years past the Wehrmacht had been given the money it had wanted for experiment and trial, but not so in Britain. Consequently, when war came, the Ministry of Supply had to rush into production with untried and unsound tank models.

Unreliable

As late as the autumn of 1942 the cruiser tanks of the British Eighth Army were still so unreliable and so undergunned that they had largely to be replaced by American medium tanks —first by the Grant and then by the Sherman. It was indeed fortunate that these reliable American tanks with their 75-mm. guns were available to bear the brunt of the Battle of Egypt.

By 1943 the position had altered. The Ministry of Supply had solved at last its fundamental problems of basic tank components—that is, of engine, gear box, tracks, and suspension. After that it was a simple matter to build up sound tanks. By 1944, too, the Rolls Royce "Meteor" engine, an adaption of the world-famous Rolls "Merlin," was available at last to give the high power ratio needed.

The Cromwell

By the spring of 1944 the Ministry of Supply was able to produce in large numbers the first really reliable British medium tank, the Cromwell. From design to production this tank's lead time had been as much as three to four years, but in 1944 it was still probably the best medium tank in the world.

The Cromwell's successors went from design into production in a matter of two years. The Germans never approached this speed record. The first of these successors was the Comet, a 33-ton medium tank with a crew of five and a speed of thirty miles an hour, which appeared in time to take part in the campaign in northwest Europe. The second was the Centurion, which appeared just too late to take part in the fighting.

Superior to German

In reliability, all three of these tanks were far superior to their German counterparts. The Cromwell, Comet, and Centurion will do two or three thousand miles before they need go in for a major overhaul. On the other hand, according to the testimony of Manteufel who commanded Rundstedt's Panzers, the Panther had to go in for

General Martin is a well-known British military analyst. At present he is military correspondent for the London *Daily Telegraph*.

major overhaul after 700-odd miles and the Tiger after only 360.

Today the Centurion is the standard tank of the Royal Armored Corps. It was designed as a "capital" tank capable of doing the jobs both of a heavy tank and of a cruiser. Its weight is 49 long British tons—the equivalent of nearly 55 short United States tons. It has a crew of four and is powered by a Rolls Meteor IV engine developing 635 brake horsepower.

Three Models Produced

Three "marks" of Centurion have now been produced. Their range is 120 road miles or 60 miles cross country, and their speed is 12 to 15 miles an hour. Further marks of Centurion with improved performance may be expected.

The Centurion III is armed with a 20-pounder gun with an extremely high muzzle velocity. Earlier marks were armed with a 17-pounder gun. Coaxially mounted with the Centurion III's 20-pounder is a 7.92-mm. Besa machine gun. The 20-pounder and the Besa are automatically stabilized, both vertically and horizontally. In addition, a free machine gun is now mounted on the turret.

Modifications Made

Since 1945 the Centurion has undergone exhaustive trials both with the British Army of the Rhine and in desert conditions in Egypt. In the process many modifications have been made and minor weaknesses eliminated.

It was in Korea that the Centurion tank first went into action. In the autumn of 1950 the 8th Royal Irish Hussars came to Korea bringing three squadrons equipped with Centurions and a reconnaissance troop equipped with Cromwells. Soon after, during the withdrawal over the River Han early in January 1951, the reconnaissance troop ran into trouble and lost nearly all its Cromwells.

Tested in Battle

The three squadrons of Centurions remained, however, to play a leading part in all the subsequent fighting on the Commonwealth front. Thus, though as yet it has had no opportunity to prove itself against enemy tanks, the Centurion has now been well tested in battle.

The best judges of a tank are its crew. It is the considered opinion of the 8th Hussars that the Centurion is the best tank in the world, with the best gun, turret equipment, and sighting gear. Very soon they came to have complete confidence in their Centurions. Nothing could stop these tanks except roads too narrow for them, or deep paddies, or almost sheer, loose rock. The Centurions would climb hills steeper in gradient than one in one.

In consequence they were able to accompany their infantry almost everywhere and thus to provide that close support that can reduce infantry losses so enormously. Arrived on crest lines 600 feet or more up, they would fire their flat-trajectory 20-pounder shells, directed with pinpoint accuracy by telescopic sight, right into the ports of the Communist bunkers. The effect was devastating.

A Legend

These Centurions established a legend that there was nothing they could not do, and they were idolized accordingly by the Commonwealth infantry. Staff officers from all the United Nations forces came to study their performance.

The Centurion can stand up to a tremendous beating. In all, the 8th Hussars had twenty-six tanks blown up. After carrying out running repairs they drove home every one of them under its own power. They could do this because of the Centurion's fine workmanship and because its drive is at the rear where it largely escapes damage from mines.

Five Tanks Lost . . .

At the Imjin River battle where the Gloucestershire Regiment won a Presidential unit citation for their gallant stand, the 8th Hussars covered the withdrawal of the 29th Brigade, crushing Communists under their tank tracks in savage close-quarter fighting. Here the 8th Hussars lost five Centurions and did not see them again for five weeks. One of these tanks had lost direction in a smoke screen and had crashed over a 12-foot drop, embedding its gun deep in the ground.

. . . and Recovered

The Communists had swarmed over these disabled tanks like monkeys, breaking electric light bulbs and stealing any movable fittings that took their fancy but showing little interest in the mechanism. The ammunition they removed and buried close by. The 8th Hussars recovered all five of these tanks and their ammunition and drove them home.

Another advantage of the Centurion is its extraordinary capacity to carry troops into or out of battle. Lieut. Col. Sir Guy Lowther, commander of the 8th Hussars, recalls how he once brought fifty-six men out of action on his own tank.

Maintenance Simple

Maintenance of the Centurion is simple. At the end of thirteen strenuous months, all passed the searching tests they had to undergo before they were handed over to the successors of the 8th Hussars in Korea.

In a farewell speech to the 8th Hussars, Maj. Gen. John O'Daniel, commander of the I United States Corps, told them that they had shown the Eighth Army that even the tops of the mountains are tank country.

"In their Centurions," he said, "the 8th Hussars have evolved a new type of tank warfare. I am honored and grateful that they have served in my corps. What they have taught us has been passed on down the line."

Others Impressed

What they have seen of the Centurion in action in Korea has also impressed both the Canadians and the Australians. Canada has already taken delivery of forty Centurions, thirty of which are to equip its armored squadron in the 27th Canadian Brigade in Germany. Some of the rest have been delivered to the 25th Canadian Brigade in Korea.

To Order 180

Canada is likely to order 180 more Centurions as soon as they are available. Hitherto the policy of the Canadian Army has been to standardize its equipment with that of the United States Army.

The Centurion is also being issued to the Royal Australian Armored Corps.

Such then is the Centurion's record. The British Army no longer regards it as a "capital" or all-purpose tank. They are content to count on it, and on future versions of it, as an unsurpassed medium-gun tank.

The new jeep speeds through obstacle tests during demonstrations at Aberdeen.

The New Jeep

An Old Campaigner Is Redesigned For Greater Power, Better Riding

F. B. Reybold

Director, Military Relations Division, Willys-Overland Motors, Inc.

THE Army's new jeep, the M38A1, is now in the field. It has undergone many tests, and, on the basis of performance to date, this new and improved version of the military ¼-ton 4x4 truck marks another milestone in the design and production of military vehicles.

Major Design Change

Specifications for its manufacture were drawn up by the Army late in 1950. They were based on suggestions made by both Army and Willys-Overland engineers, and they amounted to a major overhauling of jeep design, the first since 1941 when Willys began to mass-produce the vehicle.

Many of the changes in the new jeep, and certainly all the basic ones, were engineered on the principle of giving the jeep more power, and, among other things, better riding qualities. To be sure, power was already one of the jeep's greatest attributes and its riding qualities, discounting GI jokes, were not bad.

From the very beginning, weight was a key factor in jeep engineering. The Army's original specifications called for 2,160 pounds. The first Willys prototype models, with their 60-horsepower engines, exceeded this limit. But rather than tamper with an engine that had proved itself in extensive tests, Willys-Overland engineers reduced the vehicle's weight, piecemeal, in other places. It weighed in with just seven ounces to spare.

Weight Added

It will be remembered that two other companies made pilot models. But the Willys jeep took top honors in all tests, and it became "standard for the United States Army." With mass production, however, the Army asked that certain "small changes" be incorporated, and these changes, no matter how small, added weight. They included a new and improved air cleaner for the carburetor, a larger 6-volt generator, a 15-gallon gasoline tank, a double-bow canvas top, and a kit of pioneer tools.

Other Improvements

As time went on, with the jeep in action on the battlefield, other improvements were incorporated. After the war, when production could be interrupted to do so, still other changes were made. The tires went from 5.50 to 6.00, and the jeep got a bigger transmission and fording equipment that enabled it to go under water.

By 1949 the jeep's weight was up to 2,625 pounds, while the horsepower (60) remained the same. To Willys engineers, what was needed was more power, and they had a new engine ready. It was the 4-cylinder, F-head "Hurricane" which Willys had introduced in its all-steel station wagon in 1949.

The F-head engine has large intake valves in the head and exhaust valves in the block. It is a type of engine construction that produces remarkable power per cubic inch. It is also notable for its sturdiness and economy of operation.

The F-head engine is not new in the automobile industry, but its real virtues were discovered only a few years ago by the Rolls-Royce people. Today both Rolls and Bentley engines, Europe's finest, are of the F-head type.

New Engine

The new Willys engine, with its rating of 72 horsepower, became the answer to "more power for the jeep." With the new engine, the over-all weight of the vehicle could be raised even further to incorporate other improvements, so great was the ratio of extra power. The new jeep now weighs in at 2,675 pounds.

To achieve the desired improvement in riding qualities, rated important as a fatigue factor, Army and Willys engineers saw the answer in longer springs with greater deflection and in shock absorbers of full displacement. The longer springs required a longer frame, but this was considered desirable, too, since it would allow for making other changes and improvements.

Let's consider the new jeep as it

comes off the assembly line today. The hood has been slightly raised to accommodate the bigger, more powerful engine, but other changes in the vehicle's superstructure made this possible without raising the over-all silhouette. A larger (17-gallon) gas tank has given the jeep a greater cruising range. It will go two-thirds farther with 20 per cent more power than its more than 750,000 military predecessors.

Smoother Lines

Smoother exterior lines have given the jeep greater freedom from protruding obstructions that might hamper operations in dense growth or other close quarters. For the same reason, the basic infantry tools, the shovel and ax, were removed from the sides of the vehicle. The shovel is now attached to the underside of the engine hood, while the ax rides on the rear side panel just over the rear wheel.

Gone is the familiar bend of the jeep's body at the front seat. The result is a wider windshield and increased driver visibility. This body change also brought about an improved fitting of tops or enclosures for the vehicle. Either canvas or metal tops now can be used effectively in cold-climate areas.

The new windshield has an improved hinging device, making up-or-down adjustments a simple matter, and its increased size and design have made possible the use of built-in windshield defrosters. Windshield wipers can be operated either mechanically or manually from both the driver and passenger seats.

Booster Batteries

The new jeep is engineered to start and operate in temperatures ranging from 125 degrees above to 65 degrees below zero. If necessary, booster batteries can be attached by means of an outlet on the right side of the body. The 24-volt electrical system carries two batteries which are housed in the cowl just below the windshield.

The radio suppression system in the new jeep has a frequency range from 150 kilocycles to 1,000 megacycles, and it will not interfere with radio communications or with electronic devices such as radar, sonar, or instrument landing equipment.

A wider body (61½ inches over all) has greatly benefited the driver's compartment of the new jeep, while a longer body (139 inches over all) has provided more room in both front and rear compartments. Bigger seat cushions first appeared in postwar models at the expense of cargo capacity in the rear section. Through redesign this cargo space has been regained, plus still more space for the improved radio equipment.

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Soft plastic seats, the new shock absorbers, and the larger, longer front and rear springs together have given the vehicle greatly improved riding qualities for comfort and stability.

The tire size of the new jeep was raised from 6.00 to 7.00, giving it greater traction in mud and over other slippery surfaces. The front fenders are curved downward to serve more effectively as splash and mud guards, and the front headlights have been recessed to afford them greater protection. Wheel brakes, as well as the parking brake on the transfer case, have been improved.

The high degree of interchangeability of parts, not only with other jeeps but also with other military vehicles, has been maintained in the new model. Maintenance features also have been added. The hood is now hinged so it can be readily removed. The front grille opens forward, and quick-disconnect type wiring and electrical components allow the speedy removal of the entire engine and its component parts: radiator, hoses, bell housing, clutch, transmission, transfer case, generator, and starter. Two men without special training can do the whole job in thirteen minutes.

Like the postwar model, the new jeep has a waterproof ignition system. Snorkel kits are carried for attachment in the field where vehicles are needed for deep-water tactics. The bell housing is completely sealed to exclude water during fording operations.

Notable Achievement

By any standards the new jeep is a notable achievement and a major contribution to military efficiency and economy. Military men and civilians alike have even commented on its sleek, almost fashionable appearance. If a touch of glamour has been added, it is at best a by-product of redesign. The jeep is a utility vehicle. It is a weapon. It is a tool. It is many things to many people, but to the whole world it remains a symbol of American ingenuity and know-how.

View below shows striking contrast between old jeep, left, and new model, right.

4-A lathe gets A-1 precision with TIMKEN® bearings

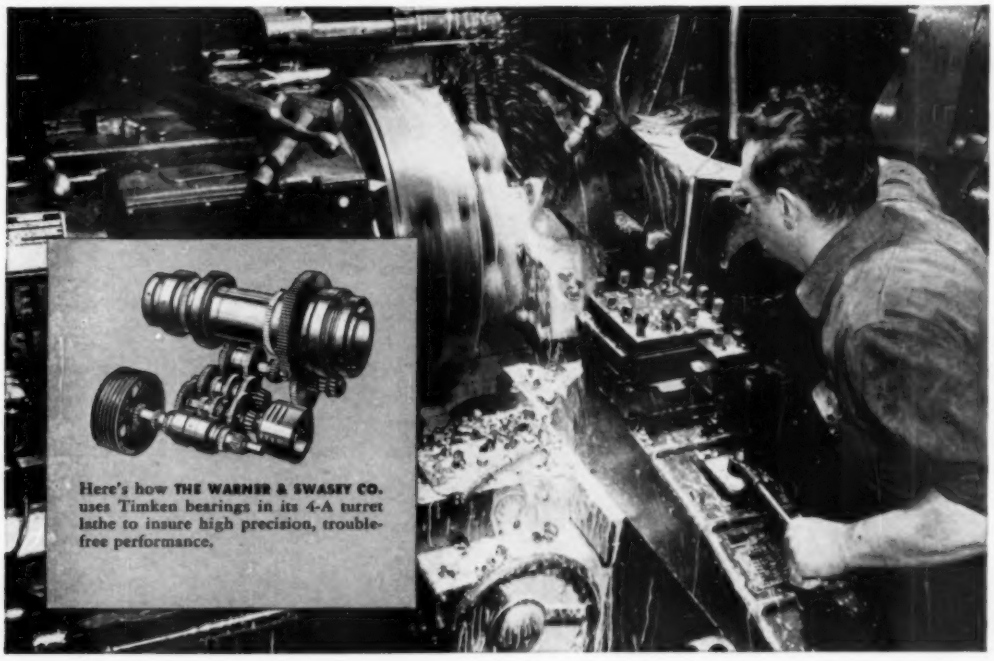
THIS Warner & Swasey 4-A turret lathe hogs off tough metal in a hurry, yet provides the high precision demanded for today's close-tolerance parts. Warner & Swasey engineers assure both precision and ruggedness by mounting the spindle and 12-speed gear train on Timken® tapered roller bearings.

Whether you're using a one-inch drill or making a 28" turning cut, Timken bearings maintain spindle precision and accurate gear mesh day in and day out. They are tapered in construction to take radial, thrust and combination loads. Line contact between rollers and races provides maximum capacity. Shafts are held in rigid alignment. Gear mesh is smoother, more accurate. Shaft wear is eliminated, gear wear reduced.

True rolling motion and an incredibly smooth surface finish combine to make Timken bearings practically friction-free. They're made from Timken fine alloy steel—finest steel ever developed for tapered roller bearings—and rollers and races are case-hardened for hard, wear-resistant surfaces and tough, shock-resistant cores.

No other bearing can offer you all the advantages of Timken bearings. Be sure to use them on the machine tools you build or buy. And look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



Here's how THE WARNER & SWASEY CO. uses Timken bearings in its 4-A turret lathe to insure high precision, trouble-free performance.

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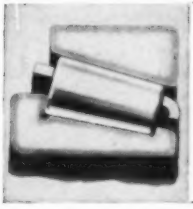
TAPERED ROLLER BEARINGS



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

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Air Strike....Submarine Style

Guided missiles launched from submarines promise to be major offensive weapons in case of war. A missile of this type travels to its distant destination under unerring electronic orders. The brain center for such missiles will be typical of the electronic systems developed and manufactured by Arma Corporation.

In close collaboration with the Armed Forces since 1918, and more recently with the Atomic Energy Commission, Arma has contributed much in basic research, design, development and manufacture to the advancement of electronic and electromechanical weapon control, navigation, and other precision remote control systems. There is every reason to believe that engineering background and techniques—first used successfully in these devices—will see widespread industrial applications. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y. Subsidiary of American Bosch Corporation.*

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